

INTERN EXPERIENCE WITH  
THE ENVIRONMENTAL LABORATORY OF THE  
U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

AN INTERNSHIP REPORT

by

Clifford Lee Truitt

Submitted to the College of Engineering  
of Texas A&M University  
In partial fulfillment of the requirements for the degree of

DOCTOR OF ENGINEERING

MAY 1987

Major Subject: Civil Engineering

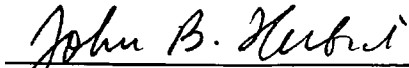
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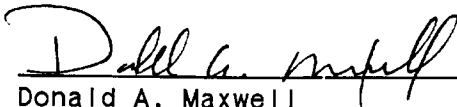
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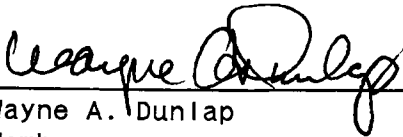
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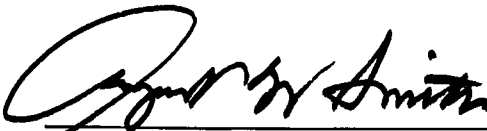
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## ABSTRACT

Intern Experience with the Environmental Laboratory of the  
U.S. Army Engineer Waterways Experiment Station. May 1987.

Clifford Lee Truitt, BS, Florida Institute of Technology;  
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This report describes an internship completed by the author with the Environmental Laboratory at the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. A statement of objectives was prepared prior to the internship to provide guidance for the experience and to allow for a meaningful assessment at its conclusion.

WES operates on a reimbursable basis to elements of the Corps of Engineers and to other agencies and provides basic research, process and equipment development and testing, and engineering design services.

Three specific technical assignments were selected to provide experiences representative of work performed in the Environmental Laboratory and the types of project roles likely to be encountered in engineering practice. In the Duwamish Waterway Capping Demonstration project the author managed and executed a complete, comprehensive engineering project examining the feasibility of an innovative dredged material disposal technique. The Indiana Harbor project provided an opportunity to function as a member of a large inter-disciplinary team in a consulting role to a Corps District. Writing an Engineer Manual developed skill in collecting and synthesizing technical information. Also, as a Team Leader, the author effectively performed primary management of a work program, personnel and fiscal resources. All objectives were fully met.

## ACKNOWLEDGEMENT

The author would like to acknowledge the cooperation and support of the Department of the Army and the Corps of Engineers. Without the official policy recognition of the importance of advanced training and education, this Internship opportunity would not have existed. The author is particularly indebted to the management of the Waterways Experiment Station, especially Dr. Montgomery, Chief, Environmental Engineering Division, Dr. Palermo, Chief, Water Resources Engineering Group and the Internship Supervisor, and Mr. Richardson, Chief, Engineering Development Division, Coastal Engineering Research Center, who all genuinely supported this effort and made the policy a reality.

The author also gratefully recognizes the guidance and help provided by the members of his Advisory Committee, Drs. Herbich, Rhomberg, Dunlap, and Smith. Their contributions extended far beyond the minimum necessary and at times included assuming an advocacy role on behalf of the author. It has been a privilege to be associated with them.

Finally, the author recognizes all too fully that both the time and attention devoted to this effort over some four years have largely been taken away from his wife, Dianne. That loss can never be repaid. I can only express to her my appreciation for her understanding and help.

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## CHAPTER I

### INTRODUCTION

This document is an Internship report submitted by the author to the College of Engineering of Texas A&M University. A formal Internship in the practice of engineering is one of the requirements of the Doctor of Engineering degree program at Texas A&M. The author's Internship was performed with the U.S. Army Corps of Engineers at the Waterways Experiment Station's Environmental Laboratory, Vicksburg, Mississippi, during the period June 1985 through May 1986.

#### Objectives

A statement of objectives was prepared at the beginning of the Internship to provide guidance for the experience and to allow for a meaningful assessment at its conclusion. These specific objectives were developed in support of the overall objective statement of the Internship portion of the Doctor of Engineering Program. The program statement declares that the purposes of the Internship are to enable the candidate to demonstrate his ability to apply knowledge and training in an identifiable manner, and to provide an opportunity to function in a non-academic environment to develop an awareness of traditional engineering approaches to problem analysis. Such an Internship requires broad experiences and assignment at an organizational level where the contributions and interactions are significant.

The specific objectives should be sufficiently general to support that breadth of exposure, yet detailed enough to allow for reasonable

measurement. The following objectives statement was submitted:

As a result of the proposed Internship experience with the Environmental Laboratory, the Intern would:

- develop an understanding of Corps management requirements and techniques that will enable him to effectively act in temporary or permanent assignments at the Group or Branch Chief level.
- be able to plan, execute, and report the results of significant engineering projects.
- be able to monitor and guide the technical progress of team members for whom he was responsible by serving as a technical reviewer of reports, proposals, and similar products.
- be able to allocate and control project funds and expenditures to within  $\pm 5$  percent of budgeted levels.
- maintain a personal commitment to professional development through participation in technical and professional societies; through preparation of professional papers; through continuing education courses; and, through attendance at training programs and seminars.
- support the professional development of team members by recommending and endorsing their participation in similar activities.

As discussed in greater detail below, the Waterways Experiment Station (WES) is the principal research, testing, and development facility of the U.S. Army Corps of Engineers. Many of the scientists and engineers at WES are engaged in narrow, in-depth research investigations, frequently extending over several years. Such a focus is not the author's professional goal, nor is it the intent of the Doctor of Engineering program. In discussing a proposed Internship, it was recognized that a typical engineering position at WES might not provide the experiences necessary to accomplish certain objectives of the type eventually formalized and submitted.



The Internship proposal, provided in draft in November 1984 and for record in August 1985, was developed to specifically address this broader need. The proposal (Appendix A) envisioned that the author would occupy a senior-level civil engineer position, but, in addition, would serve as one of two team leaders within the Water Resources Engineering Group to specifically provide for involvement in personnel, project, and resource management. Further, project assignments were chosen to provide experiences over a range of project types and in a time frame consistent with the length of the Internship. Lastly, the intern organization and broad technical subject area of the Internship were chosen so as not to duplicate the author's previous engineering experience in other disciplines.

The remainder of this chapter provides greater detail and background on the Internship setting, scope, and expectations. Subsequent chapters will review the specific assignments and accomplishments, and their relationship to the stated objectives.

## Organizational Setting of the Internship

### Overview of the Corps of Engineers

An understanding of the basic organization of the U.S. Army Corps of Engineers is useful in identifying the role of WES and in clarifying its relationships with its many clients and headquarters Army command. It is somewhat of a challenge, however, to describe the structure and missions of the Corps in these few sentences. Part of the difficulty lies in the fact that the Corps in reality is two distinct entities within the same organization; not separate and parallel, but inter-related and with many "dual-hat" roles.

Mission. The Corps is first a branch (a corps) of the Department of the Army charged with a number of military engineering missions supporting the operations of the Army. The Chief of Engineers, a three-star general, serves as the commander of this branch and is a member of the general staff of the Chief of Staff of the Army. At the same time, the Corps is charged with carrying out certain civil works activities which have been assigned to the Secretary of the Army by the Congress. In this capacity the Chief of Engineers acts in his second role as the senior engineer advisor to the Secretary of the Army (and, therefore indirectly to the Congress). An abbreviated organization chart is shown on Figure 1.

This distinction between the military and civil works sides of the Corps is not necessarily one of uniformed versus civilian personnel. In fact, it has relatively little to do with the individuals involved. Military officers command civil works projects and a civilian engineer may design military projects. The same WES engineer or scientist may

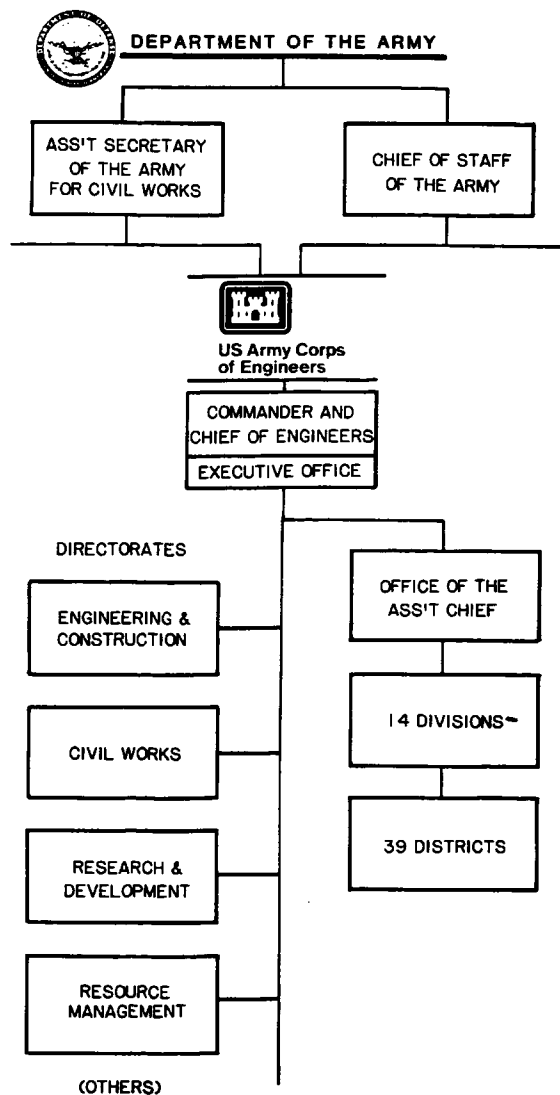


Figure 1. Abbreviated organization chart showing dual role of Corps and the major elements within OCE

work on a military project one day and a civil works project the next. The principal differences are the ways in which work is authorized, funded, and controlled. As will be discussed later, the distinction also leads to completely separate accounting systems and views of workload-workforce allocation.

Organization. In order to accomplish his civil works missions, the Chief of Engineers currently has an organization of 14 Engineer Divisions controlling a total of 39 subordinate Engineer Districts (Figure 2). He also commands four technical laboratories including WES (Figure 3) and is advised by a number of legislatively-mandated commissions composed of senior military officers and civilian representatives. Among those advisory boards, the following two are particularly important in the history and operation of WES: the Mississippi River Commission (1879); and the Coastal Engineering Research Board (formerly Beach Erosion Board; 1930). The Division Engineers report directly to the Chief of Engineers through a military chain of command, while the four laboratories report through a civilian Director of the Directorate of Research and Development in the Office of the Chief of Engineers (OCE).

#### The Waterways Experiment Station

History. As described by Cotton (1979), efforts to establish some type of national hydraulics laboratory were made several times in the 1920s. Interest varied from concerns that well established European laboratories such as the Foundation Hydraulic Engineering Laboratory at Delft would make U.S. engineering technology obsolete, to a realization of the cost savings that model experiments could mean in the design of large flood control and hydropower structures. Authorizing plans for a laboratory were drafted in Congressional committees in 1924, 1928, and 1929, but were never reported out to the floor. Early proposals endorsed, in particular, by then Secretary of Commerce Hoover called for the laboratory to be part of the National Bureau of Standards in Washington, D.C. The Corps initially expressed little interest in the idea.

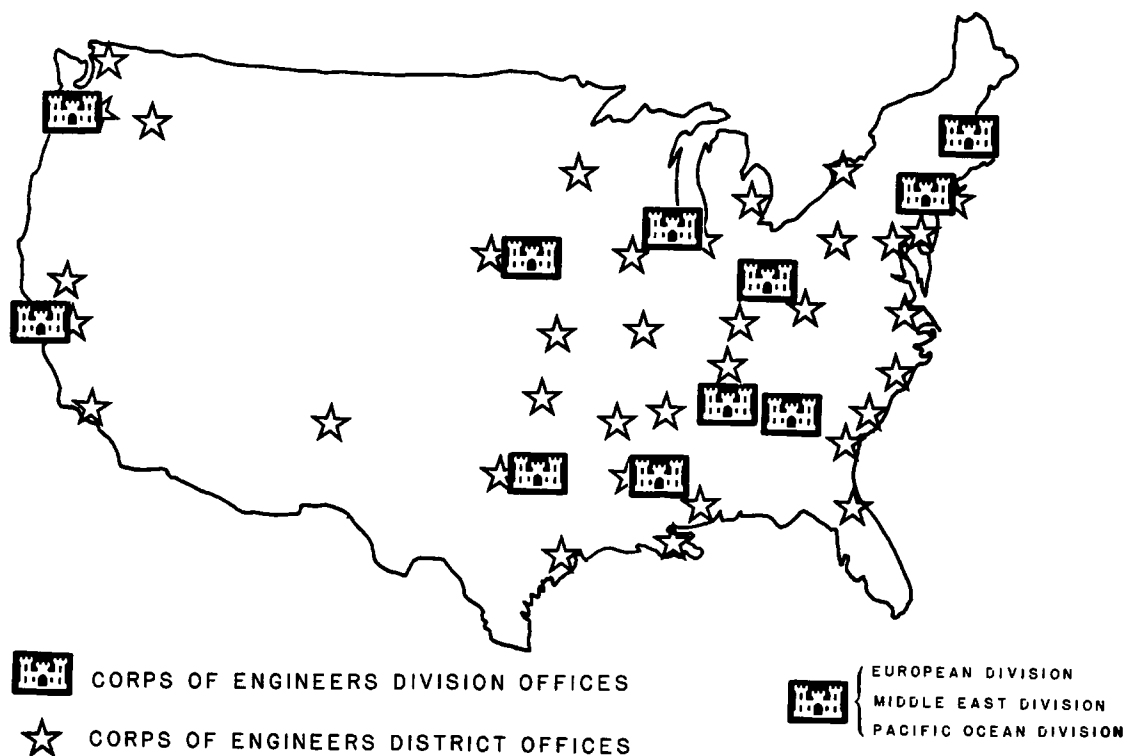


Figure 2. Corps of Engineers Divisions and Districts

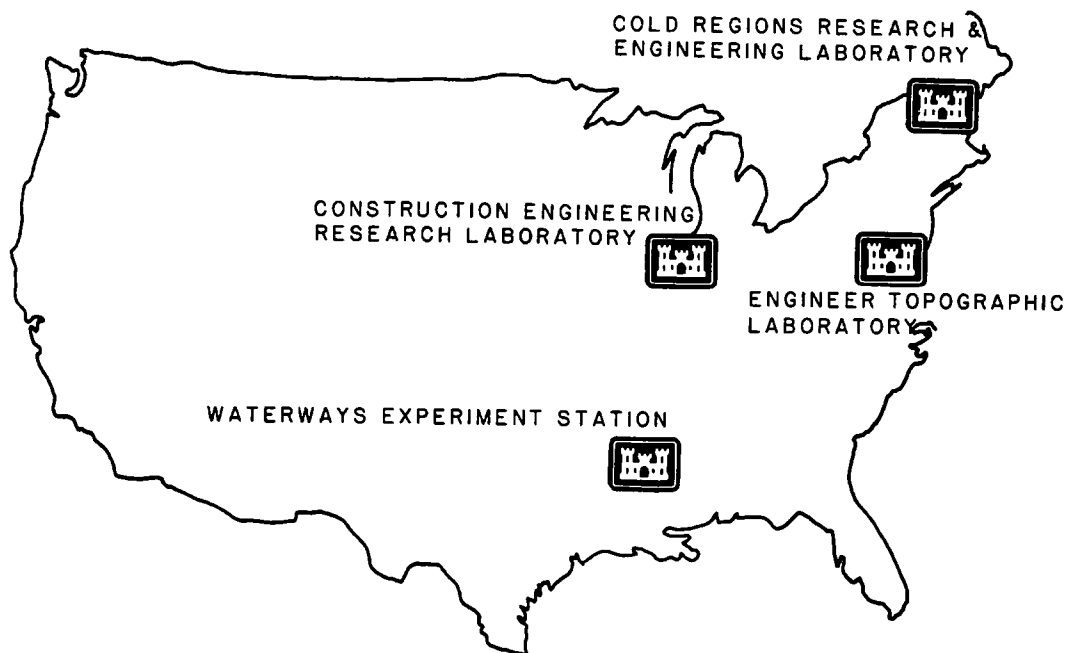


Figure 3. Corps of Engineers Support Laboratories

However, in 1927 record floods occurred in the lower Mississippi valley destroying many of the traditional protective levees and making a clear case for a new direction in flood control. The Chief of Engineers subsequently supported the establishment of a laboratory (under Corps jurisdiction) in the 1929 congressional committee hearings. When the committee adjourned without acting on the proposal, he took the matter into his own hands. In June 1929, he ordered the general officer serving as president of the Mississippi River Commission to establish a hydraulics laboratory in the Mississippi valley and provide the necessary resources and personnel to construct and staff it. The action was taken under the broad authority granted in Public Law No. 391, May 1928 (the Flood Control Act), but was without specific Congressional approval. Initial construction at a site in Vicksburg including an impoundment dam, weir, administration and headquarters building, and shops was completed in October of 1930.

Organization and missions. The organizational structure of WES has changed several times since 1930, reflecting changes in the scope of its expanding missions. The responsibility for operation and control of the Station was transferred from the Mississippi River Commission directly to OCE in 1949. Under the present structure the Commander and Director of WES is a regular Army officer of the Corps in the grade of Colonel. He is assisted by a military Deputy Director and Executive Officer (Lt. Colonel) and by a Technical Director, the senior civilian position at the Station. Most of the time there are typically 15 to 30 military officers assigned to WES in various technical or support roles, but below the level of the executive office all operational control is

accomplished through a civilian chain of command.

Prior to 1983 WES was operating through four technical divisions or laboratories: Hydraulics Laboratory, Geotechnical Laboratory, Structures Laboratory, and the Environmental Laboratory. At the time, the Corps' Coastal Engineering Research Center (CERC), located at Ft. Belvoir, Virginia, was an Independent organization with its own Commander and Technical Director. In July of 1983 CERC was transferred to become the fifth technical division at WES (Figure 4).

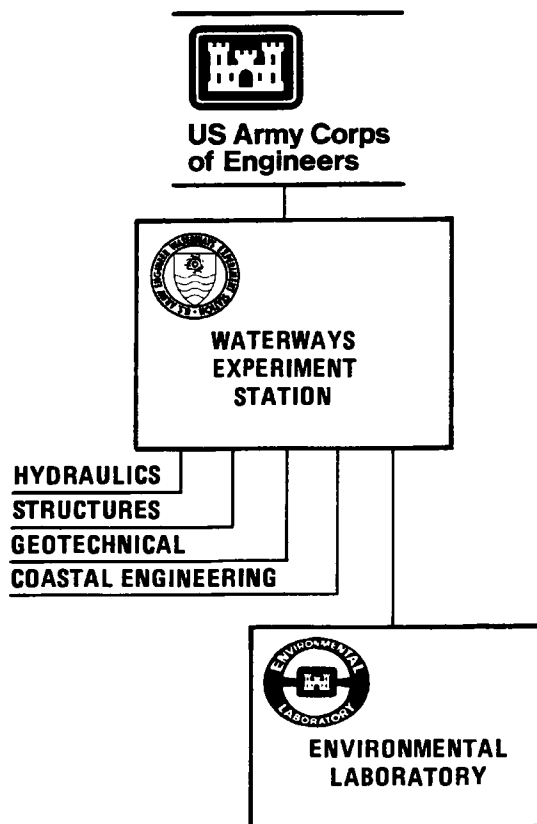


Figure 4. Technical laboratories at the Waterways Experiment Station showing the Internship organization, the Environmental Laboratory

The broad mission of WES is to conceive, plan and execute engineering investigations, and research and development studies, in support of the civil and military missions of the Chief of Engineers and other Federal agencies. The five Laboratories operate in the general fields of hydraulics, wave mechanics, coastal processes, soil and rock mechanics, concrete, expedient construction, nuclear and conventional weapons effects, explosives excavation, vehicle mobility, pavements, water quality, aquatic plants, dredged material, and general environmental relationships.

It is worth emphasizing at this point that many of the actual organizational and program names which will be used throughout this report are more the result of a mixture of institutional evolution and funding identity than literal statements of mission. Actually the mission areas among the five WES laboratories are very broad and overlapping and program assignments are at best confusing. For example, the reader is cautioned against speculating that the extensive military mine warfare research program underway at WES might be performed through the Explosion Effects Division of the Structures Laboratory. It is actually administered through the Environmental Systems Division of the Environmental Laboratory!

Complete in-house support is provided through six additional functional divisions: Administrative Services, Construction Services, Instrumentation Services, Publications and Graphic Arts, the Technical Information Center, and the Automation Technology Center. WES presently employs approximately 1600 people, over half of whom are in General Schedule (GS) professional series and grades such as "Engineering."



Operation. As a reflection of its creation and control by the Chief of Engineers, no direct Congressional appropriation is made for the operation of WES. All work is performed for the Corps and other sponsors on a reimbursable basis, with the sponsoring office, District, or program paying all costs of the work involved. It is this unusual funding basis for a government agency that results in a very noticeable "client orientation" in the approach to securing and accomplishing work. Under specific priorities and conditions, WES can also perform reimbursable work for other Federal agencies, State agencies, and even private concerns and foreign governments. In addition to the work being performed for the field offices of the Corps and for OCE, other work units underway at the Station during the Internship period were sponsored by the following organizations:

- Defense Nuclear Agency
- Army Material Development and Readiness Command
- National Aeronautics and Space Administration
- U.S. Navy
- U.S. Air Force
- U.S. Coast Guard
- Tennessee Valley Authority
- Federal Emergency Management Agency
- Environmental Protection Agency
- Department of Transportation
- Department of Energy

WES operates on the standard Federal fiscal year (FY) extending from 1 October through 30 September each year. During FY 86 Station

funding was approximately 120 million dollars (see Figure 5). Just under 60 percent of the total was derived from civil works projects with the remainder from military sources.

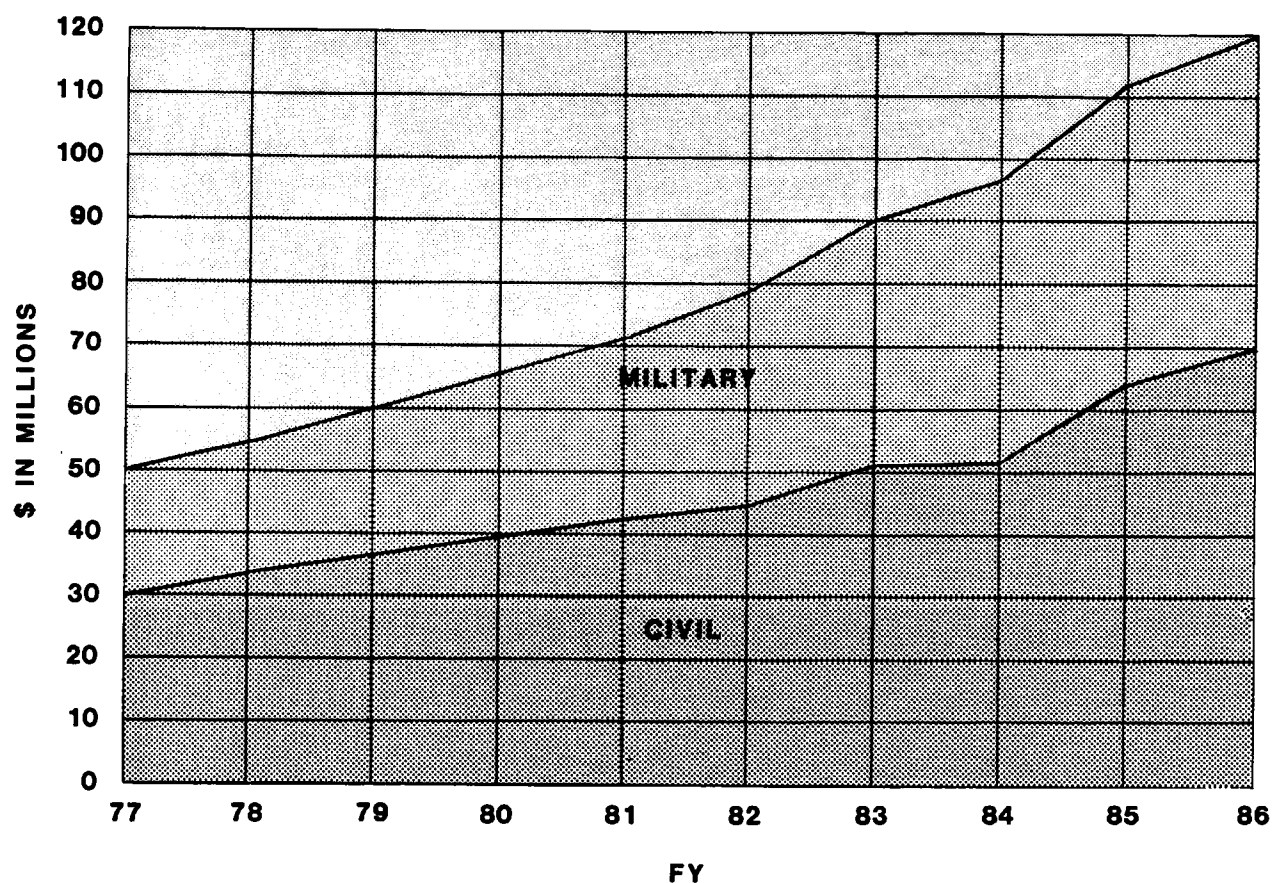


Figure 5. Recent annual funding levels at the Waterways Experiment Station

## The Environmental Laboratory

Mission. The internship was completed within the Environmental Laboratory. Environmental is one of the larger laboratories at WES, employing approximately 300 personnel and with a current funding level of 27 million dollars. Discounting the recent transfer of CERC, Environmental is also the newest WES organization, and its growth and diversification have been very rapid. The Laboratory's present formal mission statement has been paraphrased as seeking the answers to the following two questions (or two opposite sides of the same question):

- "What are the effects and impacts of the activities of man on the environment?" (Principally civil works mission(s))
- "What are the effects of the environment on the activities of man?" (Principally military engineering mission(s))

Prior to 1970, general supporting environmental science capability at WES was centered in a small Office of Environmental Studies. In the Rivers and Harbors Act of 1970, Congress gave the Secretary of the Army a civil works mission to investigate the broad area of environmental effects associated with dredging and dredged material disposal. A second small office, the Office of Dredged Material Research, was created at WES to begin the preliminary work of problem definition and scoping for this mission. In 1974 the two offices were combined to become the Environmental Effects Laboratory (and subsequently: the "Environmental Laboratory").

During the five years from late 1973 through 1978 a total of over 30 million dollars was channeled into the Dredged Material Research Program (DMRP). The DMRP was one of the largest, most intensive and widely-known research efforts ever undertaken by the Corps. Work units

were conducted in 22 topical areas covering the total range of physical, chemical, and biological processes associated with dredging and disposal. The program produced over 200 WES technical reports and many more related articles and papers. It also resulted in a great emphasis within the Environmental Laboratory on multidisciplined, team approaches to work units. That emphasis continues and is reflected in the Laboratory's organization and broad diversity of programs.

Organization. There are four operating Divisions in the Environmental Laboratory (Figure 6) with three of them roughly organized around the technical disciplines of engineering, chemical sciences, and biological sciences (EED, ERSD, and ERD respectively). There is considerable simplification in this description since technical areas overlap and do not classify well in the discrete number of Federal GS position descriptions. The fourth Division, ESD, has a broad interdisciplinary technical staff, but is narrowly focused in applications to military engineering. In addition to the operating divisions, the Environmental Laboratory uses a distinct Program Management Office and matrix organization to a greater degree than in the other laboratories at WES.

Program management. Major research units are grouped into five broad program areas headed by program managers reporting directly to the Laboratory Chief (Figure 6). At the present time the programs are:

- Aquatic Plant Control Research Program
- Environmental Effects of Dredging Programs (EEDP)
- Environmental and Water Quality Operational Studies Program (EWQOS)
- Natural Resources Research Program
- Environmental Impact Research Program

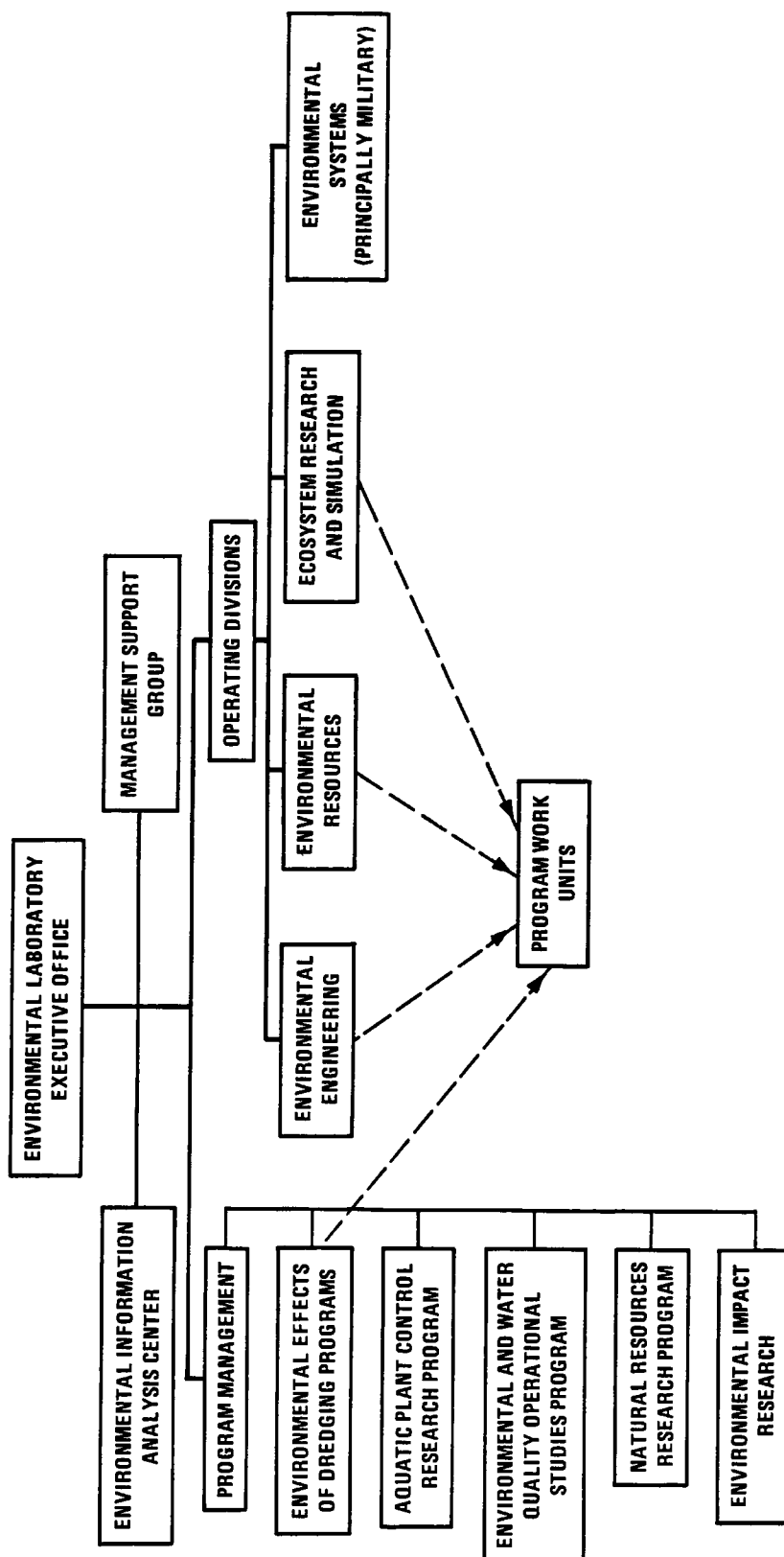


Figure 6. Organization of the Environmental Laboratory for program execution

The details of several specific work programs affecting the Internship and managed under the umbrella of the Environmental Effects of Dredging Program office will be discussed in a subsequent section.

The Program Managers are generally the point at which prospective work, especially that provided from OCE direct allotted programs, enters the laboratory. They participate in the preliminary scoping of projects and suggest appropriate staffing of the operational matrix from the technical divisions. They also provide broad fiscal management, allocate funds as received, provide status summaries, and maintain the formal program documentation. Each Program Manager's staff plans and conducts periodic program review meetings, coordinates briefings for visitors, and acts as a clearing house for the tracking, review and publication of their program products.

Operation. Even though Environmental Laboratory work units are characterized by a very high degree of multi-disciplined staffing, a single technical discipline will usually emerge as the focal point of the effort and the appropriate operating division having that primary expertise will be designated as the "lead" for the work. That Division Chief or his delegate (usually a subordinate Group Chief or senior Principal Investigator) then becomes the work unit point of contact and ad hoc program manager for the execution of the work. The work unit is then staffed by Principal Investigators as needed from across the Laboratory and from other laboratories if required. Specific sub-tasks with their own funding may be created for larger, more complex work.

As a result, a situation frequently occurs in which a particular engineer or scientist may be the senior POC on one unit, charged with

directing the work of a large, cross-organizational team, and yet may be a less senior member of other work unit teams reporting to a different POC. An employee's supervisory control still rests in the organizational chain (along with performance appraisal, timekeeping, travel orders, etc), as does primary responsibility for quality of the technical input. But he may actually work on a day-to-day basis at least partially for a different Group or Division Chief who controls his funding and workload, and has overlapping responsibility for his technical products. This situation is, of course, typical of all matrix managerial structures. The many peculiarities of organization, policy and regulations (especially accounting procedures) can make the implementation very difficult in a governmental setting.

WES, like all of the Department of Defense, is structured in the format of a classical bureaucracy. It tends to be a "tall" organization with multiple supervisory levels and fairly narrow spans of control at each level. The characteristic emphasis in such organizations on the scalar principle and unity of command is very obvious. Organizational identity is strong and benefits usually associated with matrix program teams may be overshadowed.

#### Primary-level Internship Organization

The internship position of the author was located in the Water Resources Engineering Group (WREG) of the Environmental Engineering Division (EED) (Figure 7). The Group is the lowest organizational unit in the chain of command whose chief is vested with full, formal supervisory authority. WREG is one of twelve primary Groups organized into the four Divisions that make up the Environmental Laboratory.

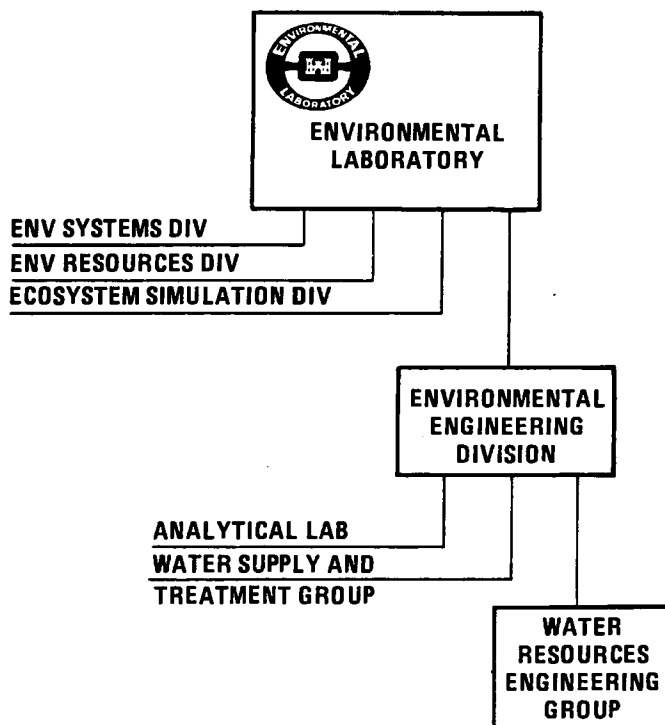


Figure 7. Formal supervisory chain from the Group to the Laboratory level

Missions and organization. WREG is involved with a number of very diverse programs spanning technical areas such as dredging operations, confined and open water disposal of dredged material, environmental effects of waterway design, water supply engineering, and landfill design/leachate control. Total Group funding during the Internship year was 1.8 million dollars. Growth in the size of the staff and continued diversity in the workload led to concerns over the effective span of control exercised by the Group Chief. A primary effort to address this situation centered on organizing Group members into two formal teams based on similar areas of technical expertise and related focus of work assignments. The resulting team structure is shown in Figure 8. The



Internship involved supervising the work of the dredging-related team. Specific position duties will be described in a subsequent section.

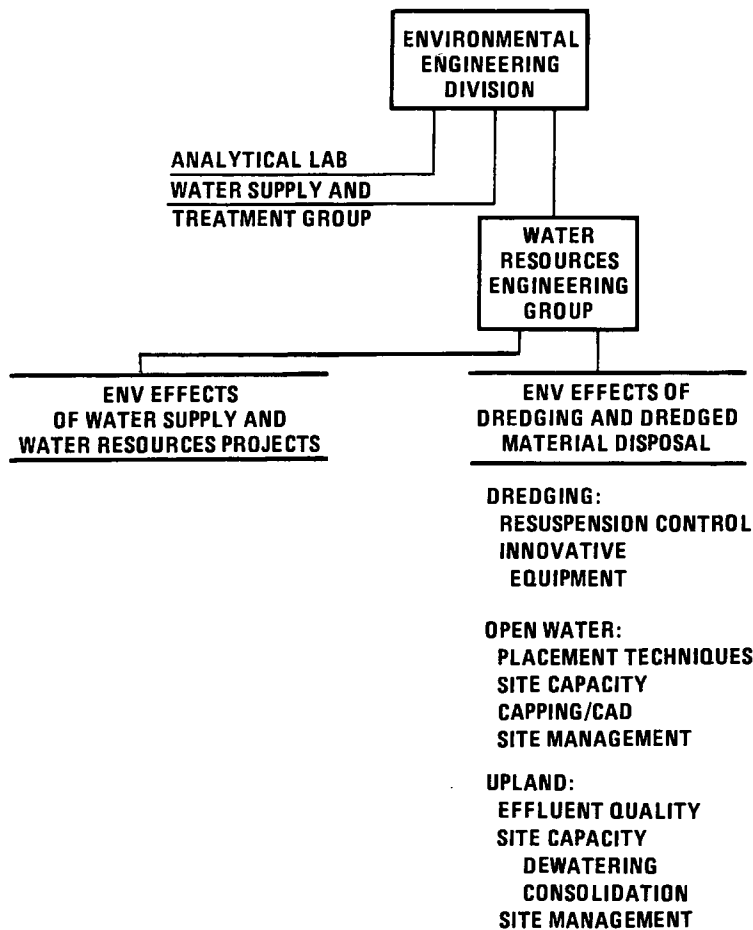


Figure 8. Team organization of the Water Resources Engineering Group showing areas of involvement of the dredging and dredged material disposal team

Staffing levels in the Group during the Internship period ranged from 16 to 23 individuals in both professional and support positions. These include full and part-time permanent Federal civilian employees,

active duty military, and university employees at WES under several types of agreements. The professional staff all occupy positions classified by Civil Service in either the Civil Engineering or Environmental Engineering series. However, their individual specializations include hydraulics/ hydrology, water resources, geotechnical, environmental, chemical, and ocean engineering.

Supervisors. The Chief of WREG during the Internship was Michael R. Palermo, P.E., Ph.D. Dr. Palermo was the author's personnel supervisor and also served as the Internship supervisor. His academic preparation includes a Bachelor's degree in Civil Engineering, Master of Science with a concentration in Geotechnical Engineering, and Doctor of Philosophy in Environmental and Water Resources Engineering. He has worked at WES since 1974 and was associated with the DMRP throughout most of its history. The focus of his technical work has been in the design of dredged material containment areas and the water quality impacts associated with dredged material disposal. Among his recent contributions to the field is the development of a modified elutriate test procedure to predict the quality of effluent from containment areas. He has been the Group Chief since 1980 and routinely acts as the operational manager and point of contact for large work units and District projects.

Dr. Palermo's supervisor and the Chief of the Environmental Engineering Division was Dr. Raymond L. Montgomery. The Manager of the Environmental Effects of Dredging Programs was Dr. Robert M. Engler and the Chief of the Environmental Laboratory was Dr. John Harrison. All three have been with the Environmental Laboratory since its beginning

and have considerable background in dredging and related disposal problems. Irrespective of its many layers, the author's entire supervisory chain was extremely accessible and their expertise was available informally in frequent discussions and advice, and formally as technical reviewers of the author's work products.

#### Summary of the Organizational Setting

WES is a unique organization both in mission and structure. The diversity of its technical involvement and capability is greater than the largest private consulting firm and most universities. Yet, it operates on a reimbursable cost basis with a decided "client" orientation. A variety of project types are found including pure research; product, process and equipment development and testing; and design services. Work is performed under both civilian and military support missions and clients have come from OCE, all Corps' Divisions and Districts, most Federal and many State agencies and occasionally foreign governments.

Two parallel management structures exist within the Environmental Laboratory at WES. The supervisory chain extends from the Laboratory Chief through a Division Chief and Group Chief to the individual. All normal personnel matters are handled through this structure (with the assistance of support elements) including performance appraisal, discipline, timekeeping, and authorization for travel and purchases. Formal upward and downward communication follows this route along with inputs to a number of recurring reports typical within the Corps.

The majority of the technical work on large interdisciplinary projects, typical of those in the Environmental Laboratory, is

accomplished through a temporarily-staffed matrix structure. Broad control and direction of most of these projects is exercised through a Program Manager's Office with general overview of scope and funding. Operational control of the project team is assigned to a senior principal investigator or the chief of a lead Group or Division. Project related communication flows diagonally and horizontally through this route.

The Internship position was located in the Water Resources Engineering Group. The Group has been organized into two operational teams roughly addressing the major division of interest and involvement between dredging related work and water supply/water resources related work. Formal supervision of the staff has been retained by the Group Chief, but work assignments, fiscal responsibility, and technical supervision was accomplished through team leaders including the author.

## Key Programs and Practices

Analogous to the description in the above section of the organizational framework in which the Internship position was located, this section describes the program framework in which the Internship technical work was performed and the policies and regulations under which the administrative duties were performed. These contexts will be described under the topical areas of major technical programs, resource accounting system, and relevant administrative practices.

### Major Technical Programs

General. The work performed under the general overview of the Manager of the Environmental Effects of Dredging Programs (EEDP) is further grouped into several large "umbrella" programs. These programs extend over periods of several years and are established with very broad objectives. Individual work units are then created within the programs for specific tasks, finite lives, and variable funding. The work units within each program have a degree of common technical focus (although overlap occurs) and their products are coordinated. However, the principal differences among the programs are frequently the nature and source of the funding. The following are the umbrella programs within which the technical work of the Internship was performed.

Long-term Effects of Dredging Operations (LEDO). The LEDO program is a relatively new effort, originally funded in FY 82. The funds for the program are within an accounting class referred to as General Investigation. Such monies are allotted each year to the Directorate of Research and Development in OCE (see Figure 1) by Congress to support

the broad R&D mission. This does not guarantee that WES subsequently receives funding for LEDO. LEDO competes for funding each year on its own merit against other R&D projects, and against proposals to perform similar work by other research entities. During the Internship period, LEDO received a total of 850 thousand dollars.

The broad direction of LEDO is toward the chemical and biological effects of dredged material disposal. Specific work units currently in progress are:

- Toxic Substances Bioaccumulation In Aquatic Organisms
- Toxic Substances Bioaccumulation In Plants
- Environmental Consequences of Bioaccumulation
- Efficiency of Capping In Reducing Cumulative Effects of Dredged Material Discharge
- Predicting Effluent Quality In Confined Disposal Areas

The work performed by the author on the Duwamish Waterway Capping Project as described in Chapter II was a LEDO task titled "Engineering Aspects of Capping Contaminated Sediments" within the [Efficiency of Capping ..] work unit. The work unit was managed by a Group Chief in the Ecosystem Research and Simulation Division and staffed primarily by investigators with backgrounds in benthic biology and sediment chemistry. The author provided the principal engineering input to the work.

Dredging Operations Technical Support (DOTS). The DOTS program has been in existence since 1978 and is quite different in funding and intent from LEDO. DOTS money is classified as Operations and Maintenance and is received from the Construction Division in the Directorate of Civil Works in OCE (see Figure 1). Operations and Maintenance funds

are the monies appropriated directly for the on-going operation of existing federal projects. It is the funding source Corps Districts use for their maintenance dredging and general navigation work. The Construction Division, with the concurrence of the Districts, directs a percentage of these funds to WES each year to support the DOTS program. The fact that OCE and the Districts are willing to part with a portion (2.2 million dollars last year) of their own funding is an indication of the success of the DOTS program.

Because of the source of funds, DOTS work is strongly directed toward supporting the needs of the Districts, and their review and input guides the program direction. In fact, approximately half of the funds are placed in a unique and innovative "DOTS Assistance" work unit reserved for reimbursement of services provided to the field. District staff having specific problems on a particular project may request, via DOTS Assistance, the short-term help of a WES engineer or scientist at no cost to the District.

Typical DOTS requests include technically reviewing proposed project designs, compiling and providing references on a technical topic, developing scopes of work for District contracts, reviewing test data and acting as quality control monitor, providing expert testimony, assisting with portions of Environmental Impact Statements, and advising on various operational problems encountered during projects. Topics are varied and the only real criteria for requesting assistance are a need that cannot be met within the District's own resources and a time commitment no longer than a few days to a week or two.

DOTS Assistance requests are treated with high priority and

frequently require interruption of other work and short notice to travel to the requesting District. In spite of this somewhat "annoying" character, the benefits of DOTS Assistance to WES are significant. Investigators who may otherwise conduct work in an isolated arena are routinely involved in the practical problems of immediate concern to the field. Personal contacts are developed and maintained throughout the Districts and the WES staff functions as a medium to transfer from one District to another information about successful (and unsuccessful) designs, approaches, and experiences. Lastly, requests frequently identify problem areas that require considerably greater detail and time, and result in subsequent reimbursable projects from the involved District.

The remaining half of the monies provided by the Construction and Operations Division are used to fund individual DOTS work units investigating specific topics in the area of dredging and disposal. The individual work units at the time were:

- Engineering Refinement (Improvement of design criteria)
- Long-term Management Strategies for Dredged Material (LTMS)
- Automated Dredging and Disposal Alternatives Management System
- Physical and Biological Monitoring Techniques for Dredging Projects
- Practical Application of Sediment Transport Models
- Beneficial Uses of Dredged Material

The author and all of the staff members of the dredging-related team within WREG were involved to some degree in each of these work units or supporting tasks. In addition, team members were Principal Investigators on the first three listed. All team members, including



the author, responded to requests under DOTS Assistance during the internship period.

Engineer Manual series. Engineer Manuals (EMs) are the traditional "How to ..." design manuals within the Corps and the formal method of technology transfer to District and Division offices. At the present time there are approximately 128 EMs in print covering a complete range of technical subjects likely to be encountered in the design or execution of any Corps project. The manuals are grouped into several series such as navigation, coastal protection, hydraulic design, soil mechanics, and a recent additional group addressing environmental effects. An EM is intended to portray acceptable, proven design practice in a subject area and must be based on well-documented prior experience and research. It is considered the official technical guide and standard within the Corps.

Manuals are written by the staff of appropriate sections at OCE, by senior engineers in the Districts, by consultants, and by the Corps laboratories including WES. Funds for particular manuals are provided directly by OCE and the final review and publication authority is retained there. Typical timeframe for production of a manual may be 3 to 5 years. Although EMs are not truly a program, there is sufficient involvement in their preparation that the Environmental Laboratory coordinates EM preparation through the Program Managers Office just as the above LEDO or DOTS work. During the internship, engineers in WREG including the author were involved in the preparation of three EMs.

Reimbursable work. In addition to the above work programs funded by elements within OCE, the Group was involved in several large

reimbursable projects supported by individual Districts. Reimbursable projects have the essential characteristics of private consulting engineering work. WES may assume one of several roles such as a short-term consultant in a specific technical area or during a specific phase; an on-going member of the project team including the District (or other sponsor) staff, private consultants, and contractors; or the prime consultant managing inputs from other areas.

Project scopes and funding are negotiated with District staff, and schedules and budgets are treated in a normal client relationship. All products, documents, and designs are considered the property of the sponsor, and subsequent publication of results by WES investigators is at the discretion of the District. The sponsor is also free to accept or reject the WES findings and recommendations. One of the internship assignments (see Chapter II, Indiana Harbor Project) was selected specifically to provide exposure to this type of reimbursable work.

#### Resource Accounting Systems

Because of the varied sources and types of project funding at WES and the diversity of organizational and individual involvement in those projects, resource management and accounting have traditionally received a great deal of emphasis. Managers at all levels and Principal Investigators are expected to monitor organizational and project funding status and effectively manage resources. Internship objectives were developed to reflect this emphasis both specifically and as a general management task.

Unlike private enterprise firms, WES is not free to choose the methods by which this monitoring and accounting will be done. The

principal method used is the Corps of Engineers Management Information System (COEMIS). COEMIS is used Corps-wide by all Districts, Divisions, and field elements. It was originally designed as a broad upward reporting system to keep OCE managers aware of the status of all aspects of Corps projects and operations. As such there are a number of "sub-systems" within the overall COEMIS. However, the most visible (and problematic) is the Finance and Accounting Subsystem. WES management tends to apply the term "COEMIS" generically when they actually mean this subsystem (and this report will continue that practice). The entire issue of resource and project management is so entwined and driven by COEMIS that a brief background and discussion of the system is presented below. Specific examples of the impact of the system on Internship tasks and projects will be developed in later chapters.

Corps of Engineers Information Management System (COEMIS). For several years after the remainder of the Corps began using COEMIS, WES continued to operate under a separate local accounting/management system (i.e., "WESMIS") that had evolved over time to address the specific local needs. However, WES was directed to convert fully to COEMIS beginning in FY 85. The subsequent conversion process included the Internship period and provided a unique opportunity to gain experience in resource management and to view the organizational response to the externally mandated change.

One of the principal difficulties with conversion to COEMIS was the fundamental orientation of the communication system. COEMIS was designed to be upward reporting. It can provide considerable information to the user, but typically in the form of summaries and extracts of

Interest to a higher level manager. The local system had operated more like a downward communication system. Although it reported upward to WES management, it went no higher. The level of detail provided by the system allowed resources to be tracked on a sub-project, task level.

For a period of months early in the conversion, project managers had no way of determining from week to week the funding balances in their work units. Numerous hand-calculated ledgers and microcomputer programs came into use across the Station. Finally, a special ADP task force developed a series of programs that ran within the COEMIS format, yet interfaced with existing data collection systems. These programs eventually allowed the Station to produce the required upward-flowing COEMIS standard reports and a parallel series of additional fiscal reports for local use (unofficially, "LABMIS"). An example of one type of report is Figure 9.

The second major problem during the conversion was a very high error rate in data entry. The existing data collection and automatic entry systems did not interface with COEMIS, formats for data were mismatched, and considerable manual keypunch was required to enter the initial data base. The first COEMIS download resulted in a 75 percent error and rejection rate resulting from format mismatches, internal system checks and actual keypunch mistakes. A typical month of operation includes over 70,000 system transactions. The system rejection rate has dropped to below 20 percent and most of these are the result of internal checks and are never seen by the project staff. However, the early problems produced a fundamental distrust and lack of confidence in the system still in evidence.

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Figure 9. Example of one type of local resource management report provided to project investigators through COEMIS

Accounting view of funding sources. The distinction between the civil and military missions of the Corps is nowhere more prominent than in the accounting system. Separate accounting is made of civil monies and military monies, and within those classes, a further separation is made between direct allotted and reimbursable funds. Thus, there are four distinct "kinds" of money and a considerable body of regulations governing what and how specific types of charges can be made against each class. The basic separation among funding sources has always been a part of Corps resource management. COEMIS, however, made the separation more visible and was less tolerant of mismatches in type of funds and type of charges.

Accounting view of labor. Prior to the implementation of COEMIS, personnel were accounted for by a traditional military "end strength system". This view is seen in the use of the Full Time Equivalent (FTE) unit for counting strength. An FTE is the equivalent of one person working 40 hours per week for one year. (Actually the definition is based on 80 hours in a bi-weekly pay period.) The term "equivalent" is used to accommodate the use of part-time and temporary employees. A part-time employee working 20 hours a week is counted as one-half FTE, and two such employees are one FTE. Authorized strength in a laboratory or division was based on an allocation of FTE (a ceiling), and there was a reasonable relationship (although not one-to-one) between the number of FTE and the actual number of employees.

COEMIS, however, does not count people: it only counts money. As a result there has been a gradual shift to a resource-based system of accounting for labor. This system can be seen in the use of the Annual

Funding Target (AFT) unit. One AFT is the labor effort available for a "unit", average salary (at the time, just over 56,000 dollars). Labor utilization at any point is reflected by the total current charges to a project divided by the unit salary. Labor allocation, or ceiling, is the total funds available for charge divided by the unit salary (hence "target"). AFT does not correlate well to the actual number of employees present, only to the labor charges made by them. AFT does, however, clearly and rapidly identify shortfalls (or excesses) in funding versus obligations for salary. As such it can be a valuable tool, even in a non-governmental setting, for preliminary project planning or scoping.

During the internship both systems were used. Labor expended on military-funded work was accounted for by AFT while most civil work was still based on FTE. The obvious problem arose when individuals worked on both military and civil projects within the same accounting period. In summary, the tracking and management of labor resources on a project required three separate and frequently conflicting views: end strength (FTE), variable resource (AFT), and actual number of employees present to do the work. The process of integrating these views was described by the Laboratory Chief as "vortexing".

#### Relevant Administrative Practices

There are a number of general administrative requirements, reports, and duties that must be accomplished at the Group level. It is no overstatement that the regulations, policy statements, and implementation guidelines governing these administrative requirements fill volumes (and change constantly). It is also a reasonable statement that the only way for a supervisor to meet these requirements is to delegate to

the maximum extent possible. In general, personnel responsibilities such as performance appraisal and discipline cannot be legally delegated. Many other recurring tasks can be, and were delegated to the team level within WREG. The following paragraphs provide a brief overview of general administrative practices, programs and areas in which the author's contributions will subsequently be described.

Timekeeping. As used in this report, timekeeping refers to collecting, summarizing and forwarding both the information (e.g., hours worked, leave taken, etc.) necessary to actually pay the employees, and similar information plus project assignments to generate the COEMIS "cost-to-job" of the labor. This process must take place bi-weekly and, with approximately 15 employees and typically 20 to 30 current jobs in progress, can be a significant administrative burden.

Cost-to-job for labor is based on an employee's actual salary times a salary multiplier that reflects overhead items such as benefits, office supplies, utilities and other Station overhead. During the internship the salary multiplier was 2.21 which is very consistent with that used in large private firms (except, of course, for profit margin).

Government performance appraisal system (GPAS). The Civil Service Reform Act of 1978 established GPAS as the government-wide performance appraisal system. The system is an objectives-based appraisal method similar in concept to Management By Objectives (MBO). A number of individual Federal agencies experimented with objectives systems in the late 1960's and early 1970's, but the 1978 GPAS regulation represents the first major, uniform approach in government to non-trait-based appraisal.



Performance appraisal should be distinguished from disciplinary action, and attempts are made through training and policy guidance to ensure that supervisors correctly apply the two systems. However, there are several characteristics of the systems that make strict adherence difficult to enforce. The positive benefits to an employee of high GPAS ratings can be so great that withholding them through low ratings is often more severe than the disciplinary actions available. At WES where there are many higher-grade engineers and scientists, all with similar education and experience, the competition for promotion, selection for advanced training, retention during personnel cuts, and other positive benefits often reduces to rating levels and consistency in past ratings. (Outright cash awards can also be made for sustained high ratings.) Ratings are generally inflated across the Station in spite of attempted quotas on the highest rating category. Actual responsibility for the appraisal cannot be delegated to other than an employee's supervisor, but many of the preliminary administrative details are delegated.

Recurring reports. There are a number of reporting requirements placed on supervisors by both administrative and program needs. The time-frames for preparation of such reports (suspense dates) are frequently very short and the data required for input can be very extensive. Data collection is often delegated and reports are "built" as they progress upward through the organizational chain.

Typical topics include various forms of "significant accomplishments" listings; status reports of particular projects or all projects in progress for a single sponsor; and organizational or personnel status reports such as total actual versus planned expenditures, or percentage

registered professional engineers on staff, society memberships, etc. Requests are often overlapping and rarely allow for submission of only "changes." Preparation time and effort are substantial.

Details to position or duties. Continuity in supervision or command of an organization is treated more formally within the Corps than in other organizations without military ties. The succession of supervision is formally stated in writing if a supervisor will be absent for more than 2 or 3 days, and is accomplished by "detail" of another individual as the acting supervisor.

In cases where the supervisor is only temporarily unavailable such as leave or travel, the detail is made to a set of duties. Both individuals retain their positions, grade, and pay, but authority to perform the necessary duties is passed for a stated period. In cases where a supervisor is on extended absence, or a supervisory position is vacant, the detail can be made to the actual position (usually with a temporary promotion). Details as an acting supervisor or to any position of increased responsibility are an important means of professional development within the Corps. Significant periods of detail to a higher grade position can be listed by an individual as creditable experience for time-in-grade and promotion purposes. The author completed the internship with such a temporary promotion and detail to the Group Chief's position as described in Chapter II.

#### Summary of Program and Administrative Setting

Technical work is typically accomplished under the broad guidelines of one of the large umbrella programs coordinated through the Program Managers' Offices or as reimbursable work for a specific sponsor.

Technical programs such as Long-term Effects of Dredging Operations (LEDO) and Dredging Operations Technical Support (DOTS) vary in their source of funding and their approach to conducting the work. Reimbursable projects and DOTS-Assistance requests provide WES expertise to clients in a manner analogous to private engineering consulting work.

Financial and other resource management data are provided to project and WES managers by locally produced spin-offs from an upward reporting system, the Corps of Engineers Management Information System (COEMIS). The recent mandatory implementation of COEMIS at WES has produced a number of effects including varying views of labor as a resource. There also appears to be a heightened awareness of the importance of having timely, accurate fiscal information.

The administrative demands on a WES supervisor are substantial. Timekeeping requirements, performance appraisal, discipline, and a number of reporting requirements are a few of these demands. Since most WES supervisors either desire, or are required, to continue some level of technical involvement in projects, effective organization and delegation are necessary management responses. Temporary detailing of subordinates to higher level positions is an important method of developing individual capability while maintaining continuity in organizational supervision.

The organization of technical work programs, the views and methods used in resource management systems, and the administrative requirements combine to create a unique institutional climate that influences decision-making. Certain types of project and organizational management options are simply screened from further consideration by that climate.

### Internship Position and Duties

As stated above and in the internship proposal (Appendix A), the internship consisted of service as a Civil Engineer, GS-12, as one of two team leaders in WREG. In order to accurately convey the scope of the internship, it is important to understand the relationship between the two functions.

The author's appointment under Federal service was to the Civil Engineer position (a vacant FTE at the time), based on past education, training and experience. Basic qualifications for appointment consideration in that series and grade are essentially the same for all positions. Further, within WREG all such positions have similar duty descriptions. The technical work accomplished on assigned projects was within the scope of that duty description and will be discussed in a subsequent section.

The function of team leader was accomplished through the assignment of a set of additional duties. No team leader position existed on the Laboratory organizational chart. The principal reason was to retain formal supervisory authority at the GS/GM-13 level, reducing the likelihood of supervisors being appointed over individuals of the same, or even higher pay grade. (Because of a generally lower grade structure in Corps District offices, GS-12 supervisors are frequently appointed.) However, the use of team leaders to supervise the conduct of work, rather than individuals, was commonly used at WES. No formal qualifications have been established for such positions and selection depends on experience and/or training outside the technical requirements, the interests of the individual, and the confidence of the supervisor. This

opportunity provided increased involvement in administrative and managerial duties.

General technical duties. A GS-12 engineer is an independent investigator charged with applying judgement and experience to broad problem areas and studies. Assignments are made by a general problem statement and objectives to be met. The individual is expected to develop the work plan, identify required resources and coordinate work with other disciplines.

Except in very rare positions, the Office of Personnel Management (OPM) is prohibited from requiring an employee to actually hold a specific academic degree or professional registration. However, a GS-12 engineer is described as typically having training beyond the masters level and experience equivalent to that required for professional registration. The equivalent American Society of Civil Engineers professional grade level is Grade V.

General technical duties on assigned work units or reimbursable projects included:

- Identify and define problems in sufficient detail to prepare scope of work, specify sub-tasks, develop preliminary approaches and schedules, and suggest form of products.

- Conduct literature searches and contact others in the field to collect information on previous data, experiences, and results.

- Define final approaches including any necessary laboratory testing, field testing, or computer simulation.

- Conduct, or arrange for, the collection of data and evaluate results to develop alternative solutions and designs.

- Report results including feasible alternatives and recommendations.

- Serve as technical reviewer of products prepared by other investigators.

General administrative duties. As noted, the technical position description presumes minimal administrative duties. The assignment as a team leader was specifically made to allow for the expanded management experiences and broader context suitable for an internship.

Assigned general administrative duties, grouped by subject area, were:

- Work program
  - Plan and organize workload assigned to team
  - Assign projects to team members, matching skill and capabilities
  - Establish priorities and preliminary schedules
  - Prepare required project/work unit documentation and status reports, and present at periodic program reviews
- Personnel management
  - Participate in recruitment and make staffing recommendations
  - Identify and recommend training needs for team members
  - Provide input to Group Chief for consideration during performance appraisal of team members
  - Ensure that timekeeping, overtime and travel restrictions are met
- Resource management
  - Assist team members in developing spending plans and initial programming of funds on new work and/or new FY
  - Coordinate and oversee fiscal charges to team projects (e.g. provide labor charges, initiate purchase orders)
  - Ensure funds are productively spent and budget goals met
  - Collect and summarize information on project and funding status for input to recurring reports and to keep Group Chief informed of progress

Chapter II provides specific assignment-related examples of the general technical and administrative duties listed above.

## CHAPTER II

### SPECIFIC ASSIGNMENTS AND CONTRIBUTIONS

#### Background

As described in Chapter I, the Internship organization (WREG) participates in a variety of project types covering a diversity of technical topics. Three projects were selected as part of the Internship assignment to provide experiences representative of that variety. The broad technical topics of these selected assignments were dredging and dredged material disposal. These topics are corollary to the author's general past experience and training in civil and coastal engineering, but were specifically chosen to provide exposure to practice areas not previously pursued in depth. A brief explanation of the basis for selection of each of the three specific assignments is presented below. Discussions of the projects follow in subsequent sections.

#### Basis for Assignments

The first assignment was the Duwamish Waterway Capping Demonstration Project. This project examined the feasibility of an innovative dredged material disposal technique termed "capping". The technique had been utilized in only a few prior cases, and with little definitive monitoring and evaluation. A carefully planned and monitored field demonstration was conducted in the Duwamish Waterway in Seattle, Washington to advance knowledge and confidence in the capping concept. This assignment was selected to provide exposure to the technical aspects of an applied research project and to project management.

A large mission support/reimbursable project for the Corps' Chicago District provided the second assignment. The District had encountered contaminated sediments in preparing for maintenance dredging in Indiana Harbor and contracted with WES to evaluate alternatives for dredging and disposing, or otherwise dealing with the contaminated reaches. As a member of an interdisciplinary project team, the author would gain experience in a reimbursable, consulting-type design project.

The third task involved preparation of a draft Engineer Manual on physical aspects of conventional open-water disposal of dredged material. This assignment was made to provide experience in synthesizing existing literature and verified techniques into a practical design/operational tool for technology transfer.

All assignments were characterized by a need for planning, interacting and coordinating with other professionals, effective communicating and careful managing of limited time, labor, and physical resources. Overviews of each assignment, the contributions made and the consequences that resulted from the experiences are presented in the following sections.



## The Duwamish Waterway Capping Demonstration Project

### Assignment Objectives

A work unit in the LEDO program had been funded to evaluate the effectiveness and utility of capping as an alternative for disposing of contaminated sediments encountered in Corps dredging projects. In-water or subaqueous capping is the controlled, accurate placement of contaminated materials at a disposal site, followed by a covering or cap of clean isolating material. Figures 10 and 11 are schematics of two types of capping projects, level-bottom and contained aquatic disposal (CAD).

The capping material provides the isolation necessary to control the movement of contaminants out of the dredged material into the overlying water column, and to prevent direct contact between aquatic biota and the contaminants. The cap also performs the important function of stabilizing the dredged material and protecting it from transport. Although conceptually valid, little systematic evaluation had been performed during the limited past experiences with capping. This work unit was directed at a comprehensive laboratory and field validation.

A major portion of the background work in capping had been performed by scientists in the Ecosystem Research and Simulation Division. This work centered on laboratory testing of different types and thicknesses of sediment capping material to establish criteria for the required contaminant isolation. It was recognized, however, that endorsement of the technique for field use required assessment of a number of engineering factors. The objective of the author's assignment was to perform that assessment and report the results of a prototype demonstration project.

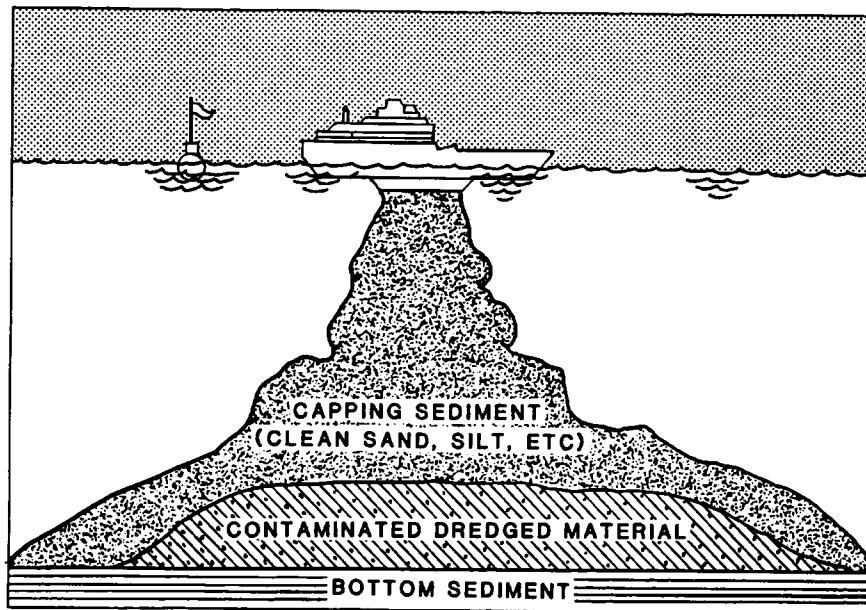


Figure 10. Schematic of typical level-bottom capping operation

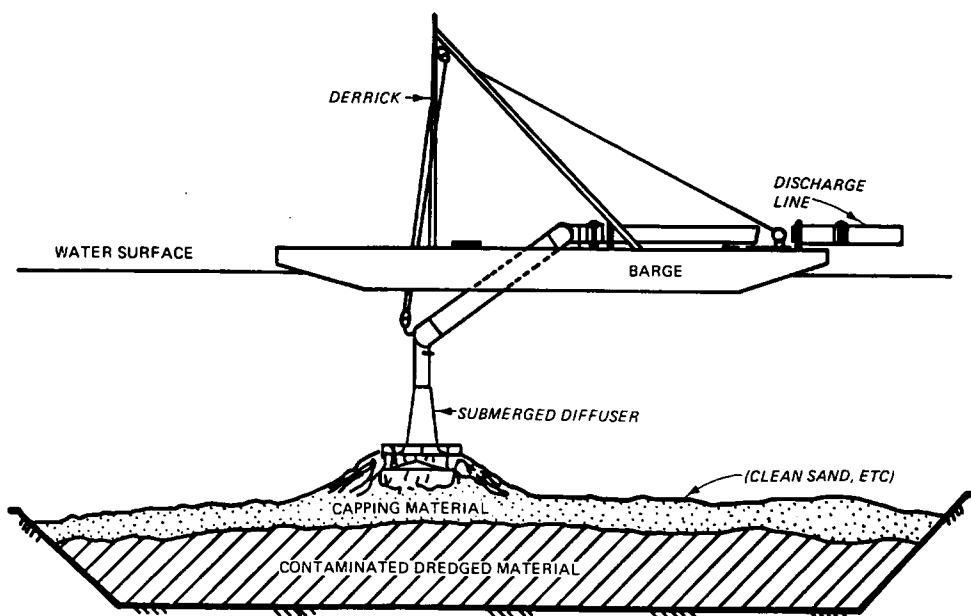


Figure 11. Schematic of contained aquatic disposal (CAD) project also showing use of submerged diffuser for placement

The following were the principal questions to be addressed:

- Could contaminated dredged material be placed in a discrete subaqueous mound with sufficient accuracy to permit subsequent location and capping?
- Could conventional dredging and disposal equipment and techniques be used to place the material and cap, or would special methods be needed?
- What types of monitoring were appropriate during construction and over the life of the project?

The work product was to be a technical report presenting the results of the demonstration, evaluating the feasibility and constructability of the technique, and identifying preliminary design guidelines for use in future projects.

#### General Project Description and Approach

A logical approach to an assignment such as this would parallel the steps in the "Scientific Method", the "Phases of Operations Research", or an analogous problem-solving framework:

1. Formulate problem
2. Collect data
3. Construct hypotheses, model system, etc.
4. Test solutions and compare
5. Feedback and refine

However, this task provided a realistic example of a required departure from the desired, logical approach. Funding of the work unit was sufficient to perform the necessary WES analysis, but not nearly sufficient to pay the operational costs of a demonstration dredging/disposal project. As a result, the work had to "piggy-back" on a

District dredging project and rely on District field assistance. The target-of-opportunity field project was started by the District earlier than expected and required adoption of a more flexible study approach.

Required approach. Certain basic background information on the concept and past projects had been collected, but an in-depth literature review and formulation of alternatives could not be accomplished prior to the initial field work. The disposal site was selected by District personnel as part of local permit requirements, and site characteristics dictated a major portion of the project design. The result was a task that necessarily began with testing of a hypothesis (the only one available) and subsequently developed the information and expertise to properly analyze the results obtained.

Project tasks. The initial field demonstration was an intensive 10-day effort that included District operations and survey personnel, and WES Investigators from the Environmental Laboratory, Hydraulics Laboratory, and Coastal Engineering Research Center. Similar, although reduced scope, efforts were repeated at 6 and 18 months following the initial disposal to evaluate long-term effects. A summary of the types of data collected and general tasks performed by the project team included:

- Replicate bathymetry at the dredging and disposal sites
- Measurement of physical site conditions (salinity, temperature, vertical current profile, etc.) before and during operations
- Collection and testing of discrete water samples for background chemical parameters
- Collection and testing of samples of sediment to be dredged to define contaminant concentrations

- Collection of sediment samples for geotechnical testing (in situ before dredging, from the disposal scow prior to release, and at the completed disposal mound)

- Collection of water samples for total suspended solids analysis; and current measurements during disposal to define behavior of turbidity plume

- Operation of side-scan sonar unit during dredging and disposal to evaluate utility for monitoring

- Coring (vibracore) of completed capped mound for verification of configuration and for sediment chemistry samples

- Placement of tiered settlement plates to measure consolidation of mound

- Use of contract divers throughout operations to provide visual confirmation and supplemental observations

#### Contributions by Author and Sources Used

General. The author began the assignment with a brief review and sorting of all of the available initial field data to ensure completeness and applicability of methods. This step was necessary since planning had to begin immediately for the 6-month follow-up monitoring effort. Techniques appeared to be suitable and no changes were made for the subsequent monitoring.

As additional data and test results became available, they were directed to the appropriate investigators for preliminary reduction and analysis. Raw bathymetric soundings were reduced and plotted as profiles by District surveyors; water and sediment chemical analyses were reviewed and summarized by ERSD scientists; side-scan sonar records were reviewed and summarized by CERC investigators; raw current meter readings were reduced by Hydraulics Laboratory technicians; and geotechnical testing was performed and reported by both WES and the District Soils Laboratory. The results of all sub-tasks were forwarded as completed to

the author for evaluation with other data and final reporting.

Technical Contributions. The author performed the following:

- Literature review. Although delayed from its normal order, a comprehensive literature review of capping was completed during the course of the assignment. A total of 23 sources were reviewed, representing the available literature on the topic. Sources included proceedings papers, WES DMRP reports on related topics, past District monitoring reports and a Masters Thesis. Valuable information on equipment and operational techniques was also collected by personal communication with several individuals in Districts and at WES.

- Assessment of site influences. The intent of this overall portion of the work was to evaluate possible influences of site conditions on the observed behavior of the jet of released dredged material. The field data collected were used to calculate profiles of salinity, temperature, and density at the disposal site. The reduced current data were summarized and plotted for each sampling station and as vector averaged values for the entire period of disposal. Tidal elevations and characteristics were obtained from the NOAA Northwest Laboratory in Seattle and plotted for the disposal operations.

- Analysis of material placement. Since one of the major objectives of the work was to evaluate placement techniques and accuracy, extensive bathymetric data were analyzed. District survey cross-sections were converted by the author using an electronic digitizer into volumetric estimates of the contaminated dredged material and capping sand in-place in the completed mound. Contour plots were constructed of the thickness of each material (e.g. Figures 12 and 13). Using procedures reviewed in a District contract monitoring report, an error analysis was performed to estimate the accuracy of depth soundings and the resulting probable range in the volume calculations.

- Mass balance. Capping is a technique applied to contaminated sediments and in such cases it is important to account for any losses of material during the handling processes. A volumetric approach can be misleading because of changes that occur in the mechanical properties of the sediment during dredging. Volumes calculated from the surveys were adjusted to mass units to provide a more realistic evaluation of sediment fate. Geotechnical test data (e.g. water content, specific gravity) from samples taken at each point in the operation were used to calculate dry weight of solids in the disposal barge and in the completed mound. The result was a trial mass balance.

As a verification of the balance and to assess potential contaminant release, sediment losses to the water column during disposal were measured directly as total suspended solids at sampling stations in the waterway. Suspended solids data from laboratory

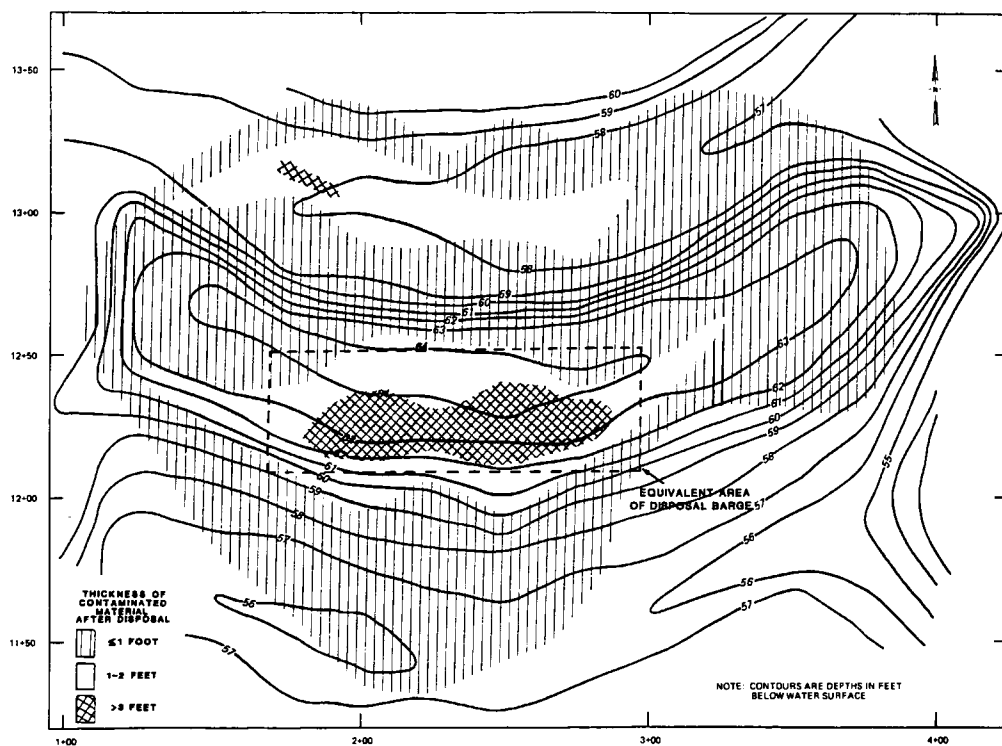


Figure 12. Contours of the thickness of contaminated material in the disposal mound

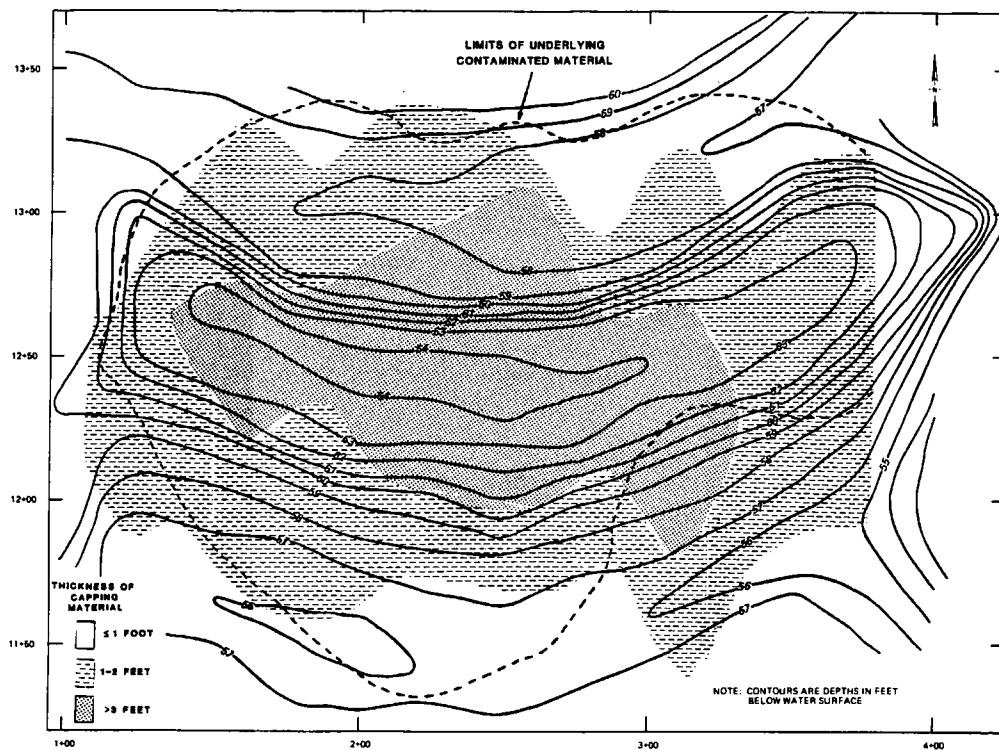


Figure 13. Thickness contours of the completed cap over the disposal mound

testing of the water samples were summarized and plotted using a microcomputer technique developed for the project to evaluate movement of the solids plume resulting from disposal (e.g. Figure 14). The total elevation in mass loading in the waterway during the disposal represents the solids stripped from the descending jet and "lost". This value was calculated and compared with the masses before disposal and after capping. Estimates agreed within error limits, providing a check on the trial mass balance.

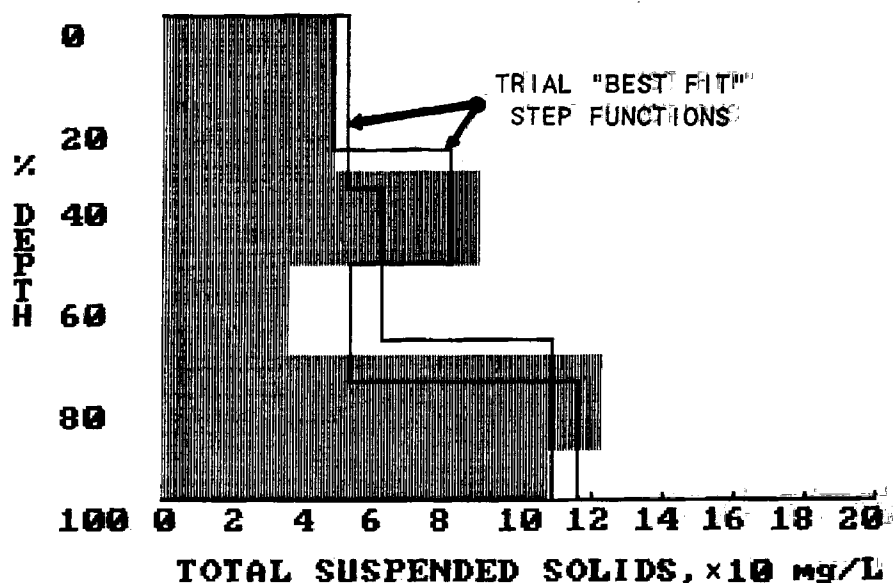


Figure 14. Typical representation of total suspended solids from single sampling event

● Reporting. All of the above data, analyses, and results were combined with results of side-scan sonar monitoring, chemical analysis of cores, and consolidation measurements to produce a project summary. The result was a 54-page WES Technical Report written by this author (with appropriate credit for data input by others). Corollary products by the author included a proceedings paper and a series of three EEDP "Tech Notes" on the general subject of capping. Publications completed during the Internship are listed in Appendix B.



Non-technical contributions. The author performed the following:

- Management of project finances. Approximately \$75,000 was allocated for this project at WES during the Internship period. This money was managed by the author to cover the costs of in-house WREG labor, overhead, travel and report preparation, and out-of-house charges for certain of the laboratory analyses and District expenses. A project spending plan was developed to estimate the amount and timing of expected charges. Labor summaries for the author's time, technician assistance and secretarial support were prepared and submitted weekly. Periodic COEMIS reports were reviewed for accuracy and the project spending plan was updated to reflect actual charges and revised projections. The project was completed exactly on budget.

- Contract monitoring. A number of direct and sub-contracts (above the funding mentioned) were used to provide specific services and equipment. For example, chemical analyses of water and sediment samples, diver services, lease of the vibracore, and fabrication of the settlement plates were all contracted by WES to the Seattle District who, in turn, let local contracts to accomplish the work. (In the case of the vibracore, the contract was to the Corps' Mobile District.) Since the funding source was originally WES, the author reviewed and helped write necessary scopes of work for the contracts, monitored execution of the work and certified performance to the Seattle contracting officer before payment was made to the contractors. Contracts on the project totaled in excess of \$100,000 and contract monitoring represented a significant task.

- Personnel coordination. In completing this project, the author was required to coordinate the efforts of 12 different individuals or entities (Environmental Laboratory divisions, other WES laboratories, the District, contractors, etc). None of these people was actually supervised by the author. Accomplishing the work on schedule and with no significant disputes required effective and often tactful communication skills and in itself represents a contribution. The experience and suggestions of Drs. Palermo and Montgomery were extremely helpful in dealing with the District personnel.

## Summary and Consequences of the Duwamish Capping Project Assignment

Significance of technical results. Technical results confirmed that dredged material could be placed with sufficient control to allow for subsequent capping and conventional equipment could be used with only minor modifications in operation. Laboratory results indicating

the effectiveness of capping as a technique for contaminant isolation were validated for the site conditions and monitoring period investigated. Comparison of only pre- and post-disposal volumetric information incorrectly suggested material losses that were much greater than the losses that actually occurred and reinforced the need for a mass balance approach rather than just a volumetric one.

An important limitation in present monitoring technology was identified. The error analysis of the bathymetry indicated that for this project, the accuracy of the volumetric estimates was no better than 8 to 10 percent of the total. The mass balance suggested that actual loss of dredged material to the water column during disposal was in the range of 4 to 7 percent of the total. The use of conventional survey methods and equipment may be insufficient to detect with confidence the losses that take place during disposal. Resource agencies in the Northwest have discussed placing maximum loss standards on disposal operations involving contaminated sediments. A standard of 5 percent has been suggested on at least one project. A consequence of this assignment was the demonstration that such a standard could not be measured within the error limits of conventional techniques. And to require its measurement would necessitate a monitoring program approaching the scope and funding of this study, or the use of more sophisticated instruments not widely available.

Limitations. An important part of the internship objective relating to project execution involves being able to identify any limitations in the general applicability of project results. Limitations in the applicability of technical results from the Duwamish Project include the

treatment of certain specific site features and assumptions made in extending measured suspended sediment concentrations and geotechnical properties to the calculation of mass loading. The disposal took place into an existing depression to evaluate the value of lateral confinement. As a consequence, numerical results on losses and spread of the mound are not directly transferrable to a level-bottom site.

The Duwamish is a linear waterway with bulkheaded lateral boundaries that channelized rotary tidal effects in such a manner that they could be treated as unidirectional currents. At an open-water site, two-dimensional effects would need to be considered.

The values of suspended solids concentration measured from discrete water samples taken at varying depths at each station were averaged over only a representative increment of depth at which they were taken. The resulting series of "slices" through the water column (see Figure 14) was an improvement in the accuracy of previous methods that calculated a single average concentration value for the entire waterbody. However, the representation of a continuous concentration profile by a discretized step function is still a limiting approximation. A similar approximation was made in the use of geotechnical test results on limited samples to represent continuously varying sediment properties in the scow and the completed mound. The specific effects of these types of approximations cannot be calculated.

The general technical conclusions reached as a result of the project are valid and transferrable. Specific values reported are limited as discussed and should be treated as approximations. Similar work should continue at open-water sites with more generic physical conditions.

Value of the assignment. This assignment provided an opportunity to manage and execute a complete project including planning the technical approach, performing portions of the work, securing and coordinating necessary additional expertise, and managing project scheduling and finances. The greatest value of the assignment was exposure to this integrated overview. The author developed an appreciation for the systemic character of project management and the need for a flexible approach.

Completion of the project within time and budget limitations required abandoning the preferred, logical step-wise approach in favor of a less elegant, opportunistic one. Subtasks were completed when opportunity, manpower, expertise and data were available. When a task became stalled for some reason, resources had to be rapidly and smoothly diverted to previously-identified parallel work to maintain momentum. This approach was necessitated not by poor planning or organization, but by the realities of lack of control over external factors and the competition by other projects for the same resources. The degree of planning required was actually greater since multiple alternatives had to be identified to deal with contingencies.

The project provided specific experience in contracting procedures and financial relationships with Districts and in using the COEMIS database.

It also greatly broadened the author's technical base by working with the interpretations of sediment chemistry and water quality data and with the investigators assisting with that work. This significantly

improved limited prior training and knowledge in these areas of environmental engineering.

Finally, the author gained valuable professional and personal exposure as a result of the assignment. Contacts were made with individuals in other organizations and disciplines that were important in facilitating later work.

## The Indiana Harbor Disposal Alternatives Project

### Assignment Objectives

Indiana Harbor is located on Lake Michigan, near Chicago, Illinois. The harbor channels are a portion of a Federal navigation project and are maintained to project depth by the Corps' Chicago District. Sediment samples taken in preparation for a maintenance dredging project several years ago were found to contain high concentrations of contaminants, including polychlorinated biphenyls (PCBs), metals and pesticides. Two reaches, totaling 200,000 cubic yards of sediment, contained concentrations sufficiently high to stop the project until comprehensive studies could be performed. The Chicago District and its parent North Central Division contracted with WES to perform the necessary work and develop recommendations for dealing with the situation.

Sediments with PCB levels exceeding 50 ppm may be subject to regulation under the Federal Toxic Substance Control Act (TSCA). Disposal alternatives for materials regulated under TSCA include incineration, placement in an approved chemical waste landfill, or some other disposal method approved by the USEPA Regional Administrator. Preliminary cost estimates indicated that disposal by either of the first two methods would be far more expensive than could be justified under the Corps' navigation maintenance authority. The only feasible option available to the District would be EPA approval of an alternative identified by the WES studies.

Recommendations (with supporting data and analyses) were to be developed addressing these general questions or areas:

- Evaluation of the "no action" alternative. Was it environmentally safer, yet economically, viable to leave the contaminants in place, allow continued shoaling and lose navigation benefits?

- What was the best method, technique and equipment to perform the dredging so that contaminant resuspension at the dredge site was minimized?

- Were there environmentally sound and economically acceptable disposal alternatives and sites to contain the required volume of contaminated sediments?

- What were the conceptual designs including sizing, construction methods, treatment/controls and monitoring guidelines for the alternatives and sites recommended in the disposal options?

While the Duwamish project provided the opportunity to personally manage a complete, but modest-size project, the Indiana Harbor assignment provided a quite different perspective. Total funding for this work during the internship period was approximately one million dollars. Almost every division in the Environmental, Hydraulics and Coastal Engineering Laboratories provided some type of input to the project. The Environmental Engineering Division was designated as the proponent for the work and Dr. Montgomery served as the project manager.

The author's specific tasks as a member of this large design team were to assist in evaluating dredging methods and equipment and to direct the work developing a capped in-water disposal alternative. Each of these elements was represented by a major section in the final project report.

#### General Project Description and Approach

Approach. The size, complexity and time constraints of this project dictated a more traditional and formal approach. Several preliminary planning meetings were held between District and Division

representatives and the WES principal staff (including the author) responsible for the major work areas. The results were identification of required tasks and testing protocols, delineation of responsibilities, and a network for prioritization and time scheduling.

The precedent project task identified was sediment sampling and characterization. Evaluation of essentially all alternatives, including "no action", was dependent on a better understanding of the chemical and physical properties of the sediment. The "sample" consisted of forty 55-gallon barrels of sediment which were homogenized and kept under refrigeration at WES to provide a stable, consistent source material for a series of tests to be performed by various WES investigators. This approach was time-consuming, but assured that subsequent opinions, decisions, and recommendations by all investigators were based on the same baseline data set.

Once the characterization data were available, additional specialized tests, modelling, technology screening and similar work was started by the project team to identify and develop alternatives. Written progress reports were prepared monthly by principal staff, forwarded to Dr. Montgomery for summary, and transmitted to the sponsor. Periodic meetings of the project team were held and presentations prepared and briefed to the sponsor as significant preliminary results or data became available. Drafts of the report sections were handled in a similar way.

Project tasks. The following is a very abbreviated description of the tasks performed by the WES staff on the Indiana Harbor project. The listing is provided to define the scope of the project and the context in which the author's contributions were made.



- Assessment of contamination potential: Initial sediment characterization (chemical and engineering); water quality evaluations (effluent, surface runoff, and leachate); plant and animal bioassay; in-place effects of "no action" (background conditions, transport mechanisms, waste load model). In many cases standard testing methods or evaluation procedures did not exist for the work and were developed by the project team based on experience and related research efforts.

- Identification and evaluation of disposal alternatives: dredging equipment evaluation; confined disposal (in-lake diked disposal facility, upland containment area); contained capped aquatic disposal (Lake Michigan sites, in-harbor sites).

- Identification of problems associated with alternatives: need for restrictions; control options and technologies available; monitoring.

#### Contributions by Author and Sources Used

General. As noted, one major area of input was the evaluation and recommendation of dredging equipment to be used if a dredging option was adopted for removal of the contaminated sediment. Objectives of the selection included minimizing resuspension at the dredgehead and producing dredged material at maximum densities/minimum site water entrainment to reduce required storage volumes and costs. Benefits realized from reduced storage and treatment costs, however, had to be weighed against increased dredging costs resulting from low production equipment or techniques, or high mobilization charges for unusual equipment.

The author and a second WREG engineer conducted the dredging evaluation as a joint effort. The other individual had been involved in previous work assessing the resuspension characteristics of various conventional dredges. It was essential, however, that this work be blended into the Indiana Harbor project in a manner integrated with the author's development of the open-water disposal alternatives. Recom-

mended dredging methods and equipment had to be compatible with the disposal scenario and equipment.

The second major area of the author's contribution was the development of the open-water capped disposal alternative. The design was constrained principally by the realization that state resource agencies and the EPA Regional Administrator would not approve conventional unrestricted disposal into Lake Michigan. The alternatives proposed used a capping technique similar to that demonstrated in the Duwamish project.

Work on this portion of the project required supporting efforts by CERC and Hydraulics Laboratory engineers to characterize and model potential sites in Lake Michigan and the harbor, and by ERSD scientists to establish criteria for the cap thickness necessary to effect chemical isolation. The author coordinated this work, managed the funds provided to the other elements, and blended their results into the final design document.

Technical contributions. The author performed the following:

- Review of available dredging technology. This task involved more than a conventional literature review. Little information has been published dealing with the resuspension characteristics of various dredges, especially when working in fine-grained sediment. The results, data and experiences from other work units were analyzed and applied where possible. Other sources of information included previous laboratory testing at Texas A&M of model dredge-heads, developers and manufacturers of special purpose dredges, and the experiences of the Dutch on a similar project in Rotterdam Harbor. Limited information had been published about the Dutch results and it was necessary to contact Corps personnel at OCE who had visited the Rotterdam project to gain their impressions, and to secure and partially translate portions of the Dutch project reports.

To fill the gaps in available data, the author scoped, arranged for and supervised supplemental work including a laboratory test at Texas A&M of proposed modifications to conventional dredge operation, and eventually a field test in the Chicago District of candidate equipment and techniques.

- Development of dredging recommendation. The information described was used to calculate estimates of suspended solids concentration as a function of water depth and distance from the dredgehead for a number of candidate types of equipment and techniques. There is a relationship (although imperfect) between sediment resuspension and contaminant transfer to the water column during dredging. The estimates of sediment resuspension were used to rank dredging equipment and techniques according to their relative ability to minimize resuspension and resulting contaminant release. This ranked listing was then screened using economic criteria and final recommendations were made for acceptable dredging methods.

- Disposal site selection. Potential in-water capped disposal sites were available in Lake Michigan and (at a depth below navigation drafts) in the harbor area itself. Using input from the sponsor and others, the author developed the technical criteria to be used in site screening. The criteria considered a number of diverse factors including: the minimum water depths to be maintained for navigation purposes, consideration of ice grounding depths, maximum practical haul distances, consideration of hull shear/prop wash effects from vessels, proximity of municipal water supply intakes and utility crossings, and allowable bottom shear stresses from currents and storm action to avoid transport of cap material.

The extensive specialized expertise and numerical modelling capability in CERC and the Hydraulics Laboratory was used to produce the actual calculations of predicted shear stress, stable grain sizes for the cap and vessel transit effects. A templating technique was then used by the author to exclude unacceptable areas and identify sites that met the criteria.

- Conceptual design of disposal sites. Preliminary designs were prepared for the alternative based on conditions at the acceptable sites, the thickness and type of cap material required, and the likely dredging and transport equipment. The conceptual designs involved calculation of the required site area using estimates of the behavior of the sediment during dredging made from geotechnical tests and past District experiences. Site configurations and schematic placement sequences were developed using general knowledge of the required marine construction, disposal equipment capabilities, available positioning/navigation technology, and assessment of site responses during storm or other contingency conditions. Site monitoring guidelines were outlined to address quality assurance during construction and environmental security over the project life.

- Reporting. Data, results and recommendations described were included as major sections of a draft engineering report presented to the District (for publications see Appendix B). This draft was reviewed by the sponsor, the North Central Division, elements at OCE, and contract consultants to the resource agencies involved.

Non-technical contributions. Although the project was managed at a higher point in the chain of command, the author was delegated a number of administrative duties that allowed for non-technical contributions. The principal contribution was the effective coordination of all sub-tasks feeding into the disposal alternative recommendations.

Time schedules were developed for the CERC and Hydraulics Laboratory work based on key decision points in the overall project network. Funding was managed at the task level, allowing the author responsibility for apportioning money to the sub-tasks and monitoring their charges. The in-water disposal work was one of only two of the major tasks that provided completed draft documents on time and within budget.

Other duties included preparation of the periodic task progress reports and participation in the briefings to the client on preliminary results. The author's contributions in planning and completing the supplemental equipment demonstration project were recognized by a Department of Army "Special Act" award certificate.

#### Summary and Consequences of the Indiana Harbor Project Assignment

Significance of technical results. The final product of the project was a comprehensive engineering report presenting results and recommendations. The following paragraphs describe the significance of the specific portions of the work to which this author contributed.

The dredging equipment evaluation resulted in identification of three acceptable alternatives: a specially fitted enclosed clamshell bucket dredge, a conventional hydraulic cutterhead dredge operated under specific guidelines, or a Dutch "matchbox" suction head dredge. The enclosed clamshell produced a measurably greater increase in suspended

solids in the upper water column than the hydraulic dredges (because of the required hoist), but significantly less total resuspension than conventional open buckets. It was retained as an alternative because of its ready availability in the Great Lakes, ability to work more efficiently in the confined harbor with minimal disruption to navigation, and lower contaminant release at the disposal site (as described in a later section).

The dredging alternatives assessment was particularly significant because it produced the first systematic, side-by-side field evaluation of dredge characteristics for the same site, sediment, and operational conditions. It resulted in the first demonstration in this country of the Dutch "matchbox" suction head dredge. Finally, it established a preliminary data set for future use in evaluating dredging as an approved technique for removing contaminated sediment in an environmentally responsible manner. Consultants on several "Superfund" clean-up projects have re-evaluated dredging as an alternative.

The area recommended for a capped aquatic disposal site was in Lake Michigan, 4 to 8 miles east of the harbor, in 40 to 60 feet of water. An artist's rendering of a feasible capped disposal site and construction sequence is shown in Figure 15. No feasible site could be identified in the harbor area that was capable of containing the required volume. Figure 16 was developed for the abandoned harbor disposal scenario, but is included to show an alternative construction sequence and equipment.

The disposal alternatives evaluation provided an important result that may have impacts on current dredging practice in the Great Lakes.

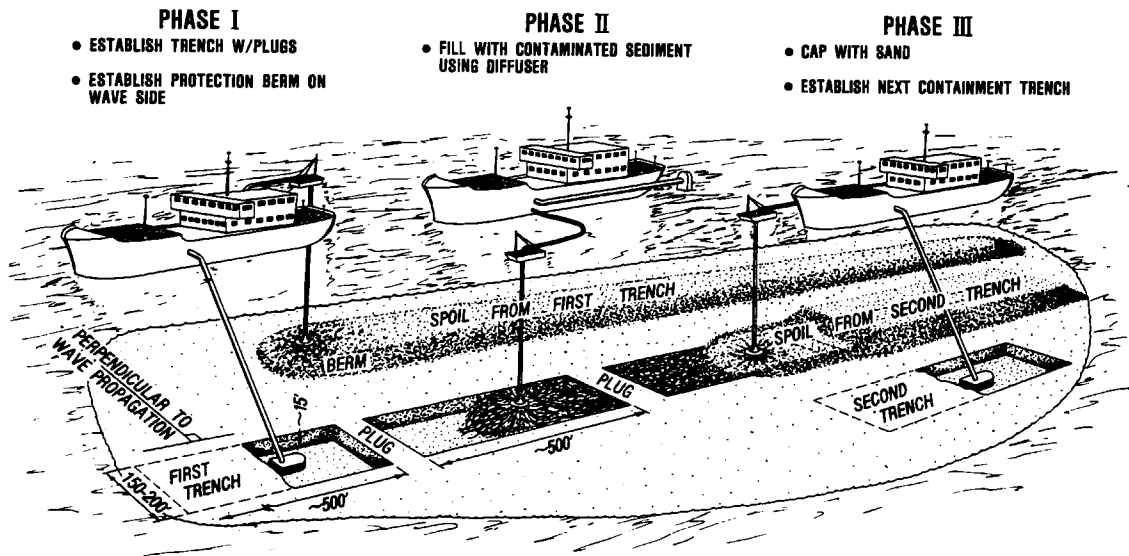


Figure 15. Schematic of construction and disposal sequence for Lake Michigan CAD site

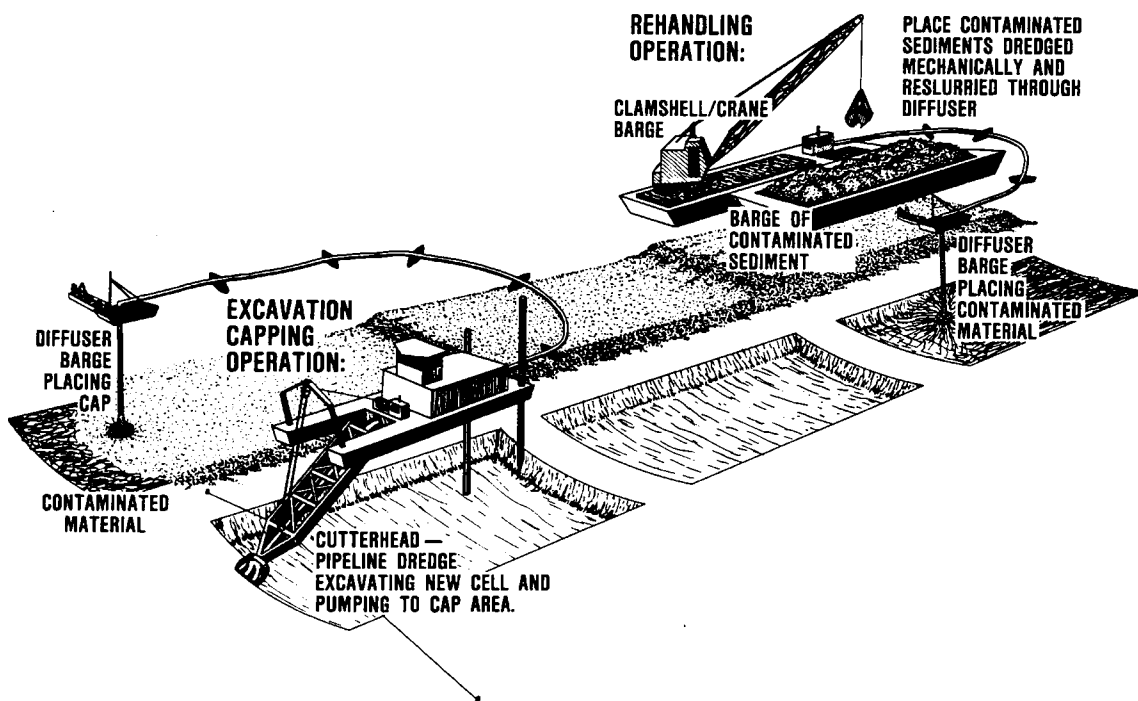


Figure 16. Schematic of alternate construction sequence showing use of different equipment types

A method commonly used in the area produces the sediment by mechanical (clamshell) dredging and transports it by scows, but the scows are not bottom-dumped as more common in conventional operations. Rather, the dredged material is reslurried and hydraulically transferred (double-handled) from the scows into diked confined disposal facilities. Estimates were made of contaminant release during disposal for the several alternatives under consideration, including this one. In general, effluent contaminant concentrations for hydraulic transfer from scows to confined disposal sites were estimated to be 5 to 6 times as high as for hydraulic dredging with direct pipeline discharge, and 50 to 150 times as high as for mechanical disposal. These results reflect the increased entrainment of site water and opportunity for mixing and release of interstitial water.

A final significant contribution was the first prototype testing and evaluation of a previously designed diffuser for controlled discharge of slurry near the disposal site bottom. Results of the diffuser tests were very positive and the equipment may have application on other projects.

Limitations. The principal limitations in the technical recommendations result from the preliminary nature of the project. Data collection and testing was confined to the minimum necessary to screen non-feasible technologies and produce valid relative rankings of remaining alternatives. More detailed development will be required for the final alternatives selected for design.

In the dredging evaluation work, some limitation in technical completeness may have resulted from an early decision to curtail the

analysis effort devoted to equipment of foreign design and manufacture. However, legislation has restricted a District's ability to contract for foreign technologies to such an extent that any evaluation results would be of little use to the project. (The Dutch dredge could be considered, fortunately, because of the existence of a U.S. licensee.)

The most limiting factor in preparing the open-water disposal alternative was the approximations made in site selection. No new field data were collected for the preliminary screening. Modelling efforts and the templating process were based on generalized estimates of site conditions taken from charts, District surveys and similar records, and probabilistic predictions. Final design will require a careful site characterization including bathymetry, bottom sediments, and navigation requirements, as well as a more precise definition of the design storm and water level events.

The product of a more detailed site investigation must be an accurate representation of cap sediment stability under design transport conditions. This will enable the design engineer to evaluate the need for measures such as armoring the cap with more stable material (e.g., larger grain size, geotextile, etc.), advanced nourishment with over-thickness of cap, and/or maintenance and monitoring requirements. The accurate prediction of transport rates and directions for cap sediments at an open-water site under a range of energy conditions is at the limit of the state-of-art. Uncertainties in the results will likely lead to a very conservative approach in order to assure that the project provides an environmentally responsible solution. As of this writing, the EPA regional administrator had still not responded formally to the proposal.



Value of the assignment. The Indiana Harbor project provided a unique technical design challenge. The problem of dredged material disposal, even contaminated material, has become more common and a certain amount of experience has been gained in dealing with it. However, the quantity and extreme contamination at Indiana Harbor and the economic and site constraints required an exhaustive assessment of conventional solutions and consideration of innovative ones. The greatest value of the assignment was the experience gained from the emphasis on development of innovative approaches and creative modifications or non-standard applications of existing methods.

Similar to the Duwamish assignment, this project also provided valuable exposure to disciplines outside the author's previous experience and training. It provided an opportunity to become familiar with the major hazardous/toxic waste control regulations and with conventional approaches to testing, classification and disposal of such materials.

The dredging equipment evaluation allowed a valuable reinforcement of general knowledge of equipment capabilities and dredging methods. This benefit was greatly enhanced by the time spent working with the dredges and their crews during the demonstration phase.

Finally, the size of the project, highly dependent and interrelated tasks, and time constraints resulted in a valuable awareness of the importance of communication and coordination. Effective coordination of the work did not always occur, despite progress reporting and team meeting requirements. The lessons learned from observing this occasional failure during the project were perhaps greater than if no problems had existed.

## Open-Water Disposal Engineer Manual

### Assignment Objectives

As discussed in Chapter 1, the Engineer Manual series is the principal source of Corps design guidance used by District staffs, and the formal mechanism for technology transfer. Manuals are developed to respond to the stated needs of the Corps field offices and to address specific problem areas encountered in project design. The proposal of a new manual, development of its scope and review of the product are carefully coordinated with representatives of the eventual target audience in the Districts.

The primary objective in this assignment paralleled the principal goal in the promulgation of an Engineer Manual: technology transfer. It was intended to provide comprehensive, measurable experience in summarizing and communicating technical ideas and procedures.

### General Project Description and Approach

There have been definite cyclic trends in favored (and environmentally acceptable) dredged material disposal techniques over the past 15 to 20 years. Open-water disposal techniques such as pipeline discharge, sidecasting, and conventional dumping were largely replaced by disposal into constructed upland confined disposal facilities (CDF) as a response to environmental concerns over turbidity impacts and similar issues.

However, as a result of significant research efforts (e.g., the DMRP) disposal impacts were quantified and found to be much less of a problem than frequently asserted. Impacts are generally limited to short time frames and confined to small benthic areas for typical non-

contaminated, even fine-grained dredged material placed at stable sites with non-critical resources. Recovery is usually rapid and complete.

These findings and the exhaustion of available upland areas for CDF construction have created renewed interest in open-water disposal. Paradoxically, it is the increased frequency of contaminated sediment occurrence in Corps projects that drives the interest. Expensive and limited CDF storage volume must be reserved for placement of the contaminated sediments (or other alternatives such as capping must be explored). Open-water disposal is again an attractive option for the clean sediments forming the bulk of a typical project, and is being met with increased acceptance by regulatory agencies.

However, much of the dredging design guidance, including Engineer Manuals, produced during the 1970s focuses on CDF design and provides limited treatment of open-water techniques. In addition, understanding of processes affecting open-water disposal has increased and a greater range of sites and methods are available. The result was a need to bring guidance on open-water disposal up to date and centralize it in a new specialized manual.

Approach. The approach to this assignment was relatively straightforward. An outline of the manual's proposed scope was drafted and approved at OCE. Information related to the topic was collected from published sources, evaluated for application, synthesized, and written in the specific required format. Following an internal WES technical review, the draft was presented to a group of selected District representatives for their comments and suggestions.

The focus of the manual was to provide an understanding and predic-

tive capability of the behavior of dredged material during and following disposal operations. The complexity of the subject was compounded by the fact that in addition to variations in the receiving environments, there are fundamentally different methods of disposal, each with unique equipment and sediment release mechanisms. Generally, the method of disposal is a direct outgrowth of the dredging method selected and the manual scope necessarily included some discussion of dredge characteristics. Other main sections dealt with typical hydrodynamic characteristics of the receiving environments, planning factors for site selection, predicting and controlling dispersion during release and methods for modelling long-term movement.

#### Contributions by Author and Sources Used

As described, the assignment began with the identification and collection of reference material on topics related to disposal. The author completed a thorough review of existing Engineer Manuals treating dredging and dredged material disposal. The DMRP program retrieval Index was utilized and copies of relevant reports reviewed. An abstract search was performed through the WES Technical Library using the DIALOG feature of the National Technical Information System (NTIS). Over 450 abstract responses were listed to the combinations of key words such as dredge material, disposal, and modeling. In addition, the Texas A&M Center for Dredging Studies abstracts were reviewed. Much of the published information collected as part of the Duwamish and Indiana Harbor projects was applicable to the manual as well and provided secondary bibliographical lists.

In spite of the apparent wealth of information on the subject, only 15 to 20 sources proved to be specifically valuable. Others were eliminated because of peripheral subject matter, dated material, speculative or unverifiable procedures, duplication, and similar reasons. Where choices were available, information was taken from existing Government documents because of their wider availability to the target audience if additional reference was desired.

Usable material was extracted, organized into the topical areas treated in the manual and re-written in the specified format.

When a final draft had been completed it was sent to six Districts for initial review (New York, Baltimore, Wilmington, Norfolk, Seattle and Portland). Contacts in each District were asked to discuss the draft with their staffs, note applicable project experiences and identify any information available locally that might have been overlooked. The six representatives were then invited to a workshop meeting at one of the participating offices to provide comments and suggestions. The author arranged and planned this review as part of the assignment. The draft was subsequently revised and submitted for further review at OCE.

#### Summary and Consequences of the Engineer Manual Assignment

Significance of contributions. The nature of this task precluded the development of new technical contributions. The contents of an Engineer Manual must reflect accepted verified design methods rather than emerging R&D. However, a significant contribution resulted from reviewing and synthesizing technical contributions by others to the subject over the past several years. The manual provides a current and

concise, yet complete, treatment of the engineering aspects of open-water disposal of dredged material.

Value of the assignment. Probably the most obvious value of the assignment was gaining the body of technical knowledge collected and transformed into the final document. No single project or other type of assignment would have resulted in such comprehensive exposure to the literature.

The experience in synthesizing and communicating technical information was perhaps more important and the greater value but, unfortunately, more difficult to quantify. Certainly, it is easy to establish that the experience was gained, but the value of the learning process for this type of task is more closely tied to the value or effectiveness of the product. If the manual effectively communicates the technical information, then the writing task was properly performed and the experience was valuable. In even the most simple communication models, effectiveness of the communication process is judged by feedback to the sender. The document was generally well received by the reviewers, the supervisory chain and OCE, but its ultimate usefulness to the field cannot be assessed until feedback is available from the users.

## Additional Contributions and Experience

### Objectives of Administrative Assignments

As discussed in Chapter I, assignment as a Team Leader was an integral part of the Internship. Although this position was not included in the formal supervisory structure, the assignment effectively allowed experience in the day-to-day management of a work program, personnel and resources.

Near the conclusion of the Internship period, the schedule of a major reimbursable project involving several WES organizations was accelerated by the client to meet new requirements. The WREG Group Chief, Dr. Palermo, was acting as the WES project manager for this work in much the same way as Dr. Montgomery managed the Indiana Harbor study. A decision was made that it was unreasonable for Dr. Palermo to continue his duties as Group Chief while meeting the increased demands of this extremely important project. Dr. Palermo was temporarily detailed to a special assignment status and the author was appointed Group Chief for 60 days (the balance of the Internship period). Unlike previous short details as an Acting Chief, this temporary assignment included promotion in pay grade and full legal authority as the organization supervisor. The period is particularly significant because it provided a windfall opportunity to directly apply the knowledge and experience gained as a Team Leader to a position of responsible charge.

### Contributions by Author and Sources Used

The following are specific tasks and contributions resulting from administrative, non-project duties.

Work program. While acting as a Team Leader, the author, with guidance from the Group Chief, made the work assignments to team members. Normally each engineer worked on 2 to 3 direct allotted work units depending on the complexity. These assignments were made at the beginning of each Fiscal Year and were based on work load projections and the interests and training of personnel. In addition to this work, however, reimbursable projects and DOTS Assistance requests were received throughout the year and new supplemental assignment of this work had to be made. This required the author to be continually cognizant of the basic scope of all work (10 major projects plus that many more smaller requests and tasks), the timing of milestones and the workload of each team member.

For each of the major projects the author prepared a required set of program documentation. This consisted of several pages setting out the need for the work, objectives, approach, proposed products and their timing, and funding levels. The documentation served as a basic work plan and was developed after discussion with the engineers to be involved on the project, the Group Chief and individuals from the appropriate program manager's office. The reviewed and approved documentation was maintained by Technical Monitors at OCE and became the formal standard against which work progress was measured.

This measurement process occurred formally twice a year in the context of scheduled program reviews conducted by the Technical Monitors and program managers with additional critique by invited representatives from Districts and academia. The author made the work unit presentations at program reviews for most of the team assigned projects. These



presentations required knowledge of work and product status, spending rates, and relationship of the specific unit to the overall program goals (as well as a basic understanding of technical results available).

In addition to managing the current team work program, the author was called on to draft scopes of work and preliminary documentation for three proposed new work units and assist in plans for four reimbursable projects.

Personnel management. While a Team Leader, personnel management was limited to non-supervisory duties. However, these resulted in important contributions by relieving the Group Chief of certain tasks.

The author undertook responsibility for recruiting student aids to supplement the limited in-house technician resource. This involved preparing a list of duties, writing a solicitation in required format, contacting several universities, conducting recruiting trips and interviews, and completing the hiring documents.

The author made similar contributions in improving and managing the identification, hiring and directing of university faculty members assisting WREG under Interagency Personnel Act (IPA) agreements.

The personnel recruited from these two programs provided an indispensable source of expertise and labor without infringing on the FTE ceilings. Developing the knowledge to make these contributions required considerable effort to become familiar with the applicable personnel regulations and processing requirements. The author contacted, visited and continued to draw on the knowledge of several key individuals in the WES Resource Management Office and Civilian Personnel Office.

The author developed a simple microcomputer spreadsheet to more

efficiently perform the task of supplying periodic labor charges for team members to the Group timekeeper. Although the system was very simple, it insured all time periods during the week were accounted for, provided totals by project, assisted the timekeeper by using a neat, consistent format, and allowed for easy recordkeeping at the team level. Formal supervisory duties were assumed during the period spent as Group Chief. These duties included certifying time cards, approving leave requests and travel orders, reviewing and certifying travel reimbursement requests, and similar tasks.

Lastly, a number of initiatives were started during this time to try to improve morale, spirit and cohesiveness in the Group. Some were proposed or started by Dr. Palermo and continued to implementation by the author, while others were original ideas. All were individually very small things, but taken in total appeared to result in a measurable contribution. The number of awards and similar instances of public recognition were significantly increased, a Group bulletin board was installed and maintained, bi-weekly meetings were begun, support personnel were approved to attend various short training seminars and workshops on "enrichment" topics, etc.

Resource management. During the internship the author was responsible for managing and productively spending approximately 800 thousand dollars total among all team projects. Accomplishing this task required considerable long- and short-range budgeting.

The author developed a second microcomputer spreadsheet to assist in this planning. The result was a spending plan for each project prepared at the beginning of the Fiscal Year. The program allowed for

Input of expected costs such as each individual's labor charges per month or an IPA contract amount. Funds were then automatically "spent down" over the year and surpluses or shortfalls identified. A number of trial budgets could be quickly examined to balance workload among the team members and allow for contingencies. This planning was done with the input and help of each team member.

Throughout the remainder of the year, the author reviewed and updated the original spending plans monthly to provide current projections. This information, together with input from each team member on work progress, was summarized and forwarded to the Group Chief. The result was a flexible communication tool rather than a rigid budget. A number of changes were required during the year, but the system allowed rapid assessment of resulting impacts to funding levels and balancing adjustments in other projects. All team projects were completed within 5 percent of allotted funds.

#### Summary and Consequences of the Administrative Assignments

The administrative assignments outside the scope of individual projects ensured the author opportunities to perform all the major functions of management. In addition, each management function was applied in program, personnel and fiscal contexts.

Using general guidance from the Group Chief and input from team members, the author planned the project work programs, developed spending plans and prepared work unit documentation and proposed milestones.

Projects were staffed by assignment of team members based on interest, expertise and workload. Additional personnel were recruited by the

author to assist in completing the work that could not be performed by in-house resources.

The author directed the team's work by providing technical advice and suggestions, acting as a single point of contact for the flow of new work into the team, and summarizing labor and other charges to be applied against each project. Several leadership initiatives were started that resulted in favorable comments and generally improved morale.

Control of the work program was accomplished by serving as technical reviewer of all team products, monitoring milestone progress, preparing and providing status reports to the Group Chief, and participating in periodic program reviews. Fiscal control was accomplished by comparing actual expenditures reported by COEMIS with spending plan projections.

Value of administrative assignments. The expanded administrative assignments allowed the author to develop personal managerial capability and specific Corps operating knowledge at a greatly accelerated rate. Acquiring this type and level of experience in a piecemeal manner, as opportunity presented itself, would normally have required a much longer period of time and would have required generalization of specific experiences to form a complete view of management duties. By assigning responsibilities and duties that were complete in managerial scope, limited only by the smaller span of control at the team level, and monitored by the objectives and supervision that were part of the internship, the author received practical experience and training in a shorter time and with an integrated perspective.

The value of this approach and effectiveness of the actual process

was demonstrated by the author's ability to assume operational control of the Group when temporarily detailed to the Group Chief's position. The offer of the temporary appointment, even though the author was junior on the staff, was an indication of confidence in the results achieved during the Internship administrative assignments.

## Summary and Consequences of Internship Assignments

The internship assignments, both technical and administrative, were chosen to be representative of the variety of tasks and experiences likely to be encountered in a career as an engineer and technical manager within the Corps at WES. During the course of these assignments, the author effectively performed the following tasks and made the indicated contributions.

- He managed and executed a complete, comprehensive engineering project examining the feasibility of an innovative dredged material disposal technique. Technical work included a literature review, evaluation of site condition influences, assessment of placement techniques and equipment, calculation and verification of a mass balance of the dredged material, and preparation of a technical report presenting the results. Although various aspects of the capping disposal concept had been partially treated by previous investigators incidental to other projects, this assignment resulted in the most complete and fully documented evaluation to date. The project also required management of substantial funds and coordination of the efforts of other professionals at WES and in the District. The project was completed on time and within budget.

- He served as a member of an interdisciplinary team providing testing, analysis and design services as consultants to a District evaluating dredging and disposal alternatives. Contributions included recommendations for dredging and disposal equipment and techniques based on a thorough review of state-of-the-art practices and a field demonstration of candidate equipment. Preliminary conceptual site designs and construction sequences were provided for consideration and further development by the client. The project required extensive interaction with other members of the design team and coordination of schedules and interim products.

- He identified, collected, and synthesized available information on prediction and control of dredged material movement in open-water disposal and produced an Engineer Manual on the subject. After additional review, this draft manual will be used throughout the Corps as the principal design guidance for such projects.

- During the internship, he served as a Team Leader, effectively performing primary management of the work program, personnel, and fiscal resources. The positive results of these efforts led to a temporary appointment as Acting Group Chief for the final 2 months of the internship and an opportunity to apply the skills developed to a position of organizational responsibility.

The Internship assignments discussed in this chapter and summarized above provided a unique and significant opportunity to produce measurable contributions. An identifiable improvement was made in the state-of-knowledge about engineering aspects of capping disposed dredged material. Innovative technologies such as the Dutch dredge and the DMRP diffuser were demonstrated for the first time in the United States and with carefully planned monitoring. Feasible site designs and construction sequences were outlined for further evaluation and possible demonstration. An Engineer Manual was written that represented the most current and complete synthesis of information available on the physical behavior of dredged material during open water disposal.

The scope and value of the experiences gained as a result of the Internship assignments were also unique and significant. The author was able to acquire the type of insight, experience and practical knowledge possible only from actually assuming responsible charge of substantial engineering investigations. The assignments were technically challenging and reinforced the need for an integrated view of the technical tasks and project administration in order to meet work, time and budget goals. The association with supervisors and co-workers, who were nationally recognized in their fields, allowed a broadening of knowledge in other disciplines. It is unlikely that any other Internship organization and assignment could have provided the range and depth of experience afforded the author at the Environmental Laboratory.

The value of the contributions made and the experience gained as a result of the Internship assignments exceeded the expectation of the Internship proposal and objectives.

## CHAPTER III

### PROFESSIONAL DEVELOPMENT ACTIVITIES

#### Continuing Education and Training

##### General

The government has recognized the relationship between individual effectiveness and organizational effectiveness. A portion of the formal policy statement on Civilian Personnel Training and Development (OP Regulation 690-1-410, 1986) states that "Training of manpower resources is a vital and contributing factor in the successful accomplishment of any mission. By increasing the effectiveness of its staff, the activity increases efficiency in the conduct of its affairs."

The federal Office of Personnel Management (OPM) is responsible for overseeing training through Training Sections and Employee Development Specialists in every DOD local Consolidated Personnel Office. Policy emphasizes that the individual employee has ultimate responsibility for self-development, but this responsibility is shared by Commanders and supervisors at all levels. Some training is mandatory, such as 40 hours of specific instruction for all newly appointed supervisors. However, most is elective and need only be job-related for selection. Employees are encouraged to prepare an Individual Development Plan as part of the annual performance appraisal process to establish goals and a specific path for career progression.

Training opportunities are almost limitless for an employee with initiative and desire. OPM offers over 200 standard courses in several program areas including personnel management, skill development,



financial management and data processing, and executive development. In addition, there are a number of programs providing both short-term and long-term training through civilian universities and similar institutions.

Finally, there are several less formal training opportunities at WES that still provide very useful specific information. The author attended voluntary workshop-type sessions on the use of COEMIS information, the timekeeping regulations/requirements, performance appraisal system, and similar subjects. In addition, a number of university faculty members, nationally-known consultants and foreign engineers or scientists visit WES each year for various reasons. Almost universally, these visitors are asked to present some type of seminar, lecture or society program during their stay. The author was able to attend many of these and benefit from the exchange of information and experiences.

#### Formal Training Completed

As part of the internship objectives, the author sought opportunities to supplement the specific Doctor of Engineering coursework with developmental training and education. Three OPM courses were completed during the internship period: "Introduction to Supervision"; "Managing for Productivity: Team and Organization Effectiveness"; and, "Management Seminar". A brief description of each course is provided in the following paragraphs and an application of the training is presented in a subsequent section.

Introduction to Supervision. This was one of the standard courses offered periodically to satisfy the requirement for initial formal

training of new supervisors. Most supervisors in the Corps (certainly at WES) have had no formal management training and OPM's requirement is probably well founded. This course provided insight into the topics and level of detail considered the mandatory minimum for a Corps supervisor.

The course met 8 hours a day for 5 days and was taught by a trainer under contract with OPM. The outline generally followed the conventional definition of the functions of management with certain expanded topics: Overview of Supervisory Responsibility, Planning, Time Management, Leadership, Communications, Delegation, Motivation, Performance Appraisal, Problem Employees, and Discipline. The text was a loose-leaf compilation by OPM of material summarized from traditional management references and recent popular literature. Instruction was provided through lecture, case studies, practical exercises, and discussion.

Managing for Productivity: Team and Organization Effectiveness.

This was an elective course focusing on understanding the impact of individual personal styles in a team or organizational setting on overall team effectiveness. The target audience was first-line supervisors, team leaders and senior investigators or project managers. One of the premises of the course was that conflicts within an organization are most frequently based on elements of personal style (e.g., biases, assumptions, exhibited behavior) rather than competency or external influence. Recognition of predictable styles and the implications of interaction between them can be used to reduce conflict and increase effectiveness.

This 3-day course was based on a packaged program titled "STYLEMETRICS" developed and copyrighted by Burgee Associates,

Consultants, Portland, Oregon. The foundation for the training was an extensive trait appraisal of participants using several inventory instruments developed by Burgee Associates. One very interesting feature of the approach was that the same inventory instruments were applied in three ways.

Participants received course materials a week before the training and were asked to first complete the inventory instrument as a self-impression. They were then directed to complete the questionnaire a second time, but answering from the perspective of how they felt others viewed them, i.e., a projected impression. Lastly, they were asked to have five co-workers complete the instruments to develop the true received impression. All results were returned to the trainer, statistically analyzed and translated into three style profiles. Comparison of these three profiles for each participant and the analysis of different profiles among participants formed the basis for discussions, exercises and group feedback.

Management Seminar. The Management Seminar was tailored by OPM to the need of Corps organizations for a short (3 half-days) locally available "refresher" for current managers and supervisors. The intent was to offer an opportunity to renew and strengthen managerial skills, especially using more recent information that might not have been available when current management received their initial supervisory training. Because of this intent, the material covered was necessarily duplicative of portions of the other two courses. However, this provided a very good framework for review and reinforcement of the material, and the perspectives of a different instructor.

The seminar included sections on leadership and communication styles measured by trait-based instruments. It also provided an insightful section on diagnosing the climate and ideology of participants' own local organizations and comparing the results to a preferred ideal. Most diagnosed climates fell short of the ideal expressed by participants, indicating that the majority of people worked under some level of dissatisfaction and stress. The seminar was taught several times over the course of a month and the target audience in each of the sessions was specifically chosen. One session was exclusively for senior managers, one for Group Chiefs, etc. The dissatisfaction with organizational climate was expressed by the participants in each session and in each case, the group generally blamed their supervisors at the next level for the gap in ideology!

#### Summary and Benefits of Additional Training

During the internship, the author took advantage of several opportunities for formal and informal continuing education and training. These opportunities included frequent technical seminars presented by distinguished visitors, workshops addressing specific administrative topics or requirements, and three formal OPM courses in the area of general management training.

The principal benefit of this training was the focusing of general information and education previously completed to the specific task of supervision in government and within the Corps. The training provided a first-round distillation of more general management theory and the translation of it to applications in a public administration context.

As a simplistic example, it identified basic legal and illegal acts

by a Corps supervisor. It related specific government programs such as the performance appraisal system to their private sector counterparts, i.e., a Management by Objectives program, so that previous education in such topics could be effectively used. It allowed a much more rapid and effective application of knowledge when the opportunity subsequently arose to temporarily assume the duties of Group Chief. In summary, the additional training eliminated a lot of time and trial-and-error experience in separating management theory from practice in the Corps.

Additional benefits resulted from repeated exposure to similar basic information, but in different course outlines and presented by different instructors. Also, the trait appraisals provided a great deal of insight into personal behavior and style as discussed more fully below. Lastly, benefits accrued from meeting other supervisors and management during the courses, establishing peer identity very early in the employment.

## Assessment of Managerial Traits

### Introduction

All individuals possess certain personality traits that tend to influence their behavior and response to situations and to other individuals. The aggregate of these traits viewed in a management context has been referred to as one's managerial style.

Interest in trait assessment began with the observation that many successful practicing managers appeared to have similar traits in common, or at least they expressed an opinion that such traits had been important in their success. One result was the popularity for many years of personality trait-based performance appraisal systems such as typical in military efficiency ratings (e.g., the individual was rated in the areas of "personal courage" or "integrity"). While few would deny the desirability of having most of the traits listed, there has never been established a conclusive link between traits and performance. Present performance appraisal is more commonly based on objectives and measurable standards.

Even though trait appraisal has limited use in a performance context, the analysis of an individual's composite managerial or leadership style may be valuable in identifying and properly considering strengths and weaknesses. In general, managers can be grouped into one of several basic styles based on their responses to questions about general personality or behavioral traits. Such groups have statistically predictable characteristics and views. It is not suggested that there is a correct or best style. However, understanding the likely responses of individuals with one style to those with another style may improve group

effectiveness and individual leadership. The result is a situational approach to managing or leading.

A limitation of style assessment is that individuals may exhibit different style approaches to different types of situations. For example, a manager may use one style in decisionmaking situations and a quite different style in disciplining (or rewarding) subordinates. Individuals may have "back-up" styles as well, that are exhibited only under stress, but which may be more important than the primary style. Also, there can be a tendency to view style in evaluative or judgemental terms.

### Style Assessment

The Doctor of Engineering coursework and additional training during the Internship provided the author with an unusual opportunity to complete several style assessment inventories and gain insight into personal managerial or leadership style. A brief summary of these results and possible implications has been included below. A detailed discussion of each of the instruments and assessment models is beyond the scope of this report. Also, the intent of this section is not to compare the assessment techniques, but to compare the resulting profiles of the author.

The Managerial Grid (copyright 1964, Blake and Mouton). The Managerial Grid is one of the earliest and most widely known graphic representations of a style model. The grid is a positive normative two-dimensional matrix reflecting the relationship or interplay within the manager's style of four factors: Purpose, People, Power, and Philosophy. The horizontal axis of the grid is usually labeled "Concern for Purpose

(or Production)" indicating the relative importance of task- or objective-influence in the leader's philosophy. The vertical axis is labeled "Concern for People" suggesting the relative influence of employee morale and acceptance on the manager's behavior. Position on the grid is noted by a coordinate pair ranging from "1/1" for the origin to "9/9" for the opposite maxima.

Blake and Mouton (1964) identified and described five "pure" styles based on position on the grid. Two of the pure styles are the mutually exclusive concerns, 9/1 and 1/9. A 9/1 style has maximum concern for task or production and is relatively little influenced by concern for people. The 1/9 style is, of course, the opposite extreme. Three other points, 1/1, 5/5 and 9/9, represent some attempt at compromise, balance, or integration of views. Results were based on scoring and analyzing responses to a questionnaire about behavior in a number of work situations or relationships. Rather than actually plotting the resulting position on the grid, the current approach in administering the instrument is to produce scores in each of the five pure style areas and note which of the five is the dominant style.

The author completed the inventory and the scores indicated a statistically significant tendency toward the 5/5 style of leadership. As a result, several inferences can then be drawn about the author's likely approach to typical management situations and the responses of subordinates to these approaches. The general description of this style is a middle-of-the-road philosophy, avoiding direct conflict, and exercising a moderate degree of control, frequently through some mechanism such as Management by Objectives.



Assessments using the Managerial Grid are frequently evaluative and suggest that there is, in fact, a preferred style (9/9). (The results do not have to be evaluative. For example, considerable benefit can result from simply noting the nature of the likely relationship between a 9/1 manager and a 1/9 subordinate, irrespective of judgements about either style.) However, in an evaluative context the author's 5/5 style is less than ideal, but at least recognizes the need for balancing concerns.

Criticisms of the 5/5 style are based on the fact that concern in either area (People or Production) is not maximum and does not promote the synergy resulting from commitment and strong team identity. Subordinates of a 5/5 leader may become over-flexible, too ready to respond to both sides of an issue. They may try to do enough to "get by", but not enough to be labeled as over-aggressive. Communication is generally two-way, but can be restricted to vertical channels with little peer dialogue.

A number of other observations and interpretations can be made from the results of this assessment. However, a summary of the author's likely managerial style based on the Managerial Grid would include descriptors such as underplayed, compromising as necessary while retaining major control, organized and compartmentalized thought.

Multiple Management (copyright 1982, 1987, A. W. Smith). Multiple Management is a behavioral-based model that seeks to predict likely responses to managerial situations. It recognizes the fact that styles may differ in response to different general types of situations or requirements. Separate diagnostic instruments are administered in

Decision-making/Information processing, Motives, Stress/conflict management, Time management, and Indicative or composite style.

Smith (1985) graphically represents the results using a complete two-dimensional Cartesian coordinate system. The horizontal axis is labeled "Intentions" with the positive direction indicating stable Intentions or greater concern for plans and objectives. The negative direction of the same axis suggests adaptive Intentions concerned with change or feelings. The vertical axis is labeled "Interventions" (or actions). Positive intervention indicates an emphasis on direct action, short-term tactics and a judgemental view. The negative direction on the vertical axis suggests indirect approaches, long-term strategy and a perceptual view.

The resultants in each of the four quadrants represent the four "pure" styles of the model: I. Implementor, II. Intervenor, III. Initiator, and IV. Investigator. Certain generalizations are possible about the behavior of individuals with each style in applicable work situations or relationships.

The author's scores showed fairly balanced grouping with two quadrants' scores just over the threshold for indicative styles and two just below. The predominant style was "Intervenor" (quadrant II) and the second significant style was "Implementor" (quadrant I). A number of interpretations and "overlays" for various situations are possible for these results. But a summary of several descriptors for the two styles on the upper half of the matrix include emphasis on priorities and expediting, negotiation to reduce risk, and balance between behavioral emphasis and process emphasis.

Stylemetrics (copyright 1981, Burgee Associates). The Stylemetrics model identifies dominant behavioral styles and further attempts to measure the balance between styles and the degree of visibility of each style. The question of visibility is addressed through an audience-received impression based on an inventory completed by co-workers. Obviously the consequences of a manager's style based on his own responses to an inventory are moot if that style is not strongly visible to the audience, or he projects something else in actual situations.

The graphic used in Stylemetrics is a four-quadrant "pie chart". Opposing factors on the upper half of the graph represent "Views", and range from task to relationship orientation. The opposing descriptors on the lower half, or "Mode", range from a reflective to assertive approach.

Scoring based on the author's self-impression suggested a stronger tendency toward a task-oriented view, but a very balanced mode, equally reflective and assertive. Analysis of the scores indicated that the author also felt this style was strongly visible, unmistakable and consistent.

The audience impression was scored from the results of inventories completed by five co-workers. These results confirmed the apparent task-oriented view. However, the projected mode was significantly different than the self-impression and revealed that the audience felt the true style was much more reflective and less assertive than believed. Perhaps more revealing was that the audience results suggested very low visibility of the style.

The combinations of view and mode result in five "pure" styles with

predictable behaviors. The author's "Precisive" style (based on audience reception) includes descriptors such as formal, cautious, systematic and thorough in pursuit of goals, attention to detail but indecisive, builds elaborate support for ideas.

#### Summary and Conclusions about Managerial Style Assessment

As a result of Doctor of Engineering coursework and training courses during the internship, the author had a unique opportunity to pursue a very interesting and insightful comparison of his own potential managerial styles measured by three different models.

The predominant or likely style predicted by all three models based on self-assessment using situational and trait inventory instruments was generally consistent. Certain differences in the predicted style resulted from variations in the intent and scope of the models used. However, similar behavior descriptors appeared. These suggest that the author had a primary task orientation with a balanced approach to implementation, compromising between assertive and reflective personal roles. The author felt this was a strong, visible style.

The leadership style predicted by the responses of five co-workers to one model's assessment instrument was somewhat different. This projected style was more reflective, less intervening, and generally not as strongly projected as believed.

The differences did not represent radically opposing views, but were significant enough to conclude that the impression of the projected leadership style and the received style were not the same. Explanations for the difference may include lack of experience in formal self-evaluation using such inventories; initial presentation of one style in

a situation, but a shift to a "back-up" style as a situation develops; and a combination of over-concern for balance and a low visibility resulting a reflective appearance. The author felt reasonably comfortable with the resulting style descriptions so that improvements should be attainable at the margin without resorting to a very atypical or artificial complete change in style.

Regardless of the actual style results, this experience provided valuable insight into the role of behavioral styles in situational responses. The influence of personality traits and individual behavior on the outcomes of common work situations and organizational effectiveness is likely to be stronger than the influence of individual technical competency and organization structure. This did not appear to be a widely held view at WES. Greater importance was placed on structure and individual effort with a presumption that effectiveness would follow.

## Technology Transfer

Technology transfer is simply the effective communication of technical information, designs, results and data to potential consumers. The caveat "effective" is used to stress that the information must be received in a form that is understandable and usable by the consumer. The author strongly concurs in the view that effective communication of products and information, i.e. technology transfer, is one of the most important tasks in engineering practice.

The importance of technology transfer is emphasized at WES. WES exists to serve the field elements of the Corps and other clients, and all work must result in specific products that are transferable to the field. This emphasis is a part of the general work climate within the Environmental Laboratory, but is also a specific factor in an individual's performance appraisal. Each WREG engineer had a job element (in fact a critical element) listed on the Government Employee Performance Appraisal System (see Chapter 1) worksheet dealing with technology transfer.

The importance of technology transfer is also recognized in the structure and objectives of the Doctor of Engineering Program. The Doctor of Engineering Program Manual notes that technological advances must be implemented through business and industry, and that there must be an inherent interaction between technology and society. One role envisioned for Program graduates is to provide leadership in such areas.

The author's internship allowed an opportunity to develop and demonstrate competency in technology transfer. Examples include formal publications, oral presentations at client briefings and WES-sponsored

training courses, and attendance at professional society meetings.

These are briefly described in the remainder of this section.

Appendix B lists eleven formal publications which the Intern authored or co-authored as a result of the Internship at the Environmental Laboratory. The publications include major engineering reports for project sponsors (e.g., the Indiana Harbor report), WES Technical Reports and Miscellaneous Papers, and conference proceedings papers. Circulation of these products (when released by the sponsor) is widespread. For example, 960 copies of the Duwamish Technical Report were printed and distributed. Distribution of the EEDP Technical Note series is approximately 1800. All publications represented significant identifiable contributions of technology with potential application in society.

In addition to published technology, the author participated in several sponsor briefings which required oral presentations of technical results and designs. He also presented a block of formal instruction on the capping concept in two training courses dealing with dredged material management and presented a conference paper. These experiences required assessment of the needs of the audiences, careful organization of material, development of visual aids, effective oral delivery, and knowledgeable responses to subsequent discussion and questions.

Participation in professional societies provides a mechanism for technology transfer among the participants as well as other professional development benefits. As described above, many visitors to WES were called on to speak at meetings and seminars so that the WES staff could benefit as the recipients of technology transfer.

The author regularly attended local chapter meetings of societies

In which he holds membership such as the American Society of Civil Engineers (ASCE) and the Society of American Military Engineers (SAME). In addition, the WES library subscribes to almost every major engineering journal published, and a routing system is used to circulate copies in applicable technical areas for review. The author's own development benefited from seeing and hearing positive examples of effective technology transfer.

In summary, the author's internship included several professional development activities that provided training, experience and insight into organizational and personal behavior and into effective communication of technology in human-scale terms.



## CHAPTER IV

### APPLICABILITY OF THE DOCTOR OF ENGINEERING PROGRAM

#### Career Goals and Objectives

##### Introduction

This section briefly summarizes the author's general professional experience and goals in order to establish the applicability of the Internship and the overall Doctor of Engineering Program. As noted in the VITA, the author had several years of professional experience before deciding to resume his formal education. That decision was the result of conflicting views about past and future career paths and is reviewed because it is illustrative of the very situations the Doctor of Engineering Program seeks to address.

##### Experience and Evolution of Objectives

The author's baccalaureate education was in a pure scientific field and his first professional assignment in a consulting firm was technical in scope as typical for entry level positions. However, in a relatively short period of time he assumed significant non-technical assignments including co-responsibility for opening a new branch office, client development, and project management, eventually leading to an associate position in the firm.

The subsequent decision after several years to leave that firm and accept a position in State government was based on a number of personal and professional considerations. One of them, however, was a general discomfort with the idea of having largely abandoned a technical

background and assumed non-technical duties for which he was untrained and generally unmotivated.

Although the engagement in State government was professionally progressive, it also began essentially as a purely technical position. Within four years the author had moved through the positions of Section Head and Chief Engineer, and was appointed Bureau Chief with full responsible charge of the organization. Again, technical involvement had reduced to a general oversight role. The author apparently discharged his duties satisfactorily, but he again felt uncomfortable with his total lack of training and preparation to function in the political and administrative arenas. This discomfort and the fact that most of the staff engineers who worked for the author had higher levels of technical education contributed to the decision to pursue graduate studies at Texas A&M University.

Initially the principal objective of that decision was to recover lost technical skills in order to again seek a more narrow technical or scientific engagement. However, apparently the several years of practical involvement with budgets, personnel, and court testimony left a residual impression that surfaced on its own in planning the graduate work. In the degree plan for the Master's degree, the author requested that the limited elective coursework include accounting and management. As he continued courses beyond the Master's degree, it finally became clear that the original objective did not truly reflect personal capabilities, nor provide a realistic expectation for the future after leaving campus.

This realization resulted from finally accepting the fact that

administrative duties had not been just a minor deviation in an otherwise technical career. Rather, the management of technology had comprised the largest percentage of the author's career to date, and provided a source of success and even unconscious satisfaction. He had been promoted over more experienced engineers into positions of greater breadth, visibility and impact in two very different engineering organizations. Instead of ignoring this history and seeking to avoid future non-technical assignments, a more realistic approach would be to gain all the formal training possible in these areas, combine it with applicable past experience and enhanced technical skills, and aggressively seek future work in the administration and practical applications of engineering.

To that end, the author explored several alternatives including the MBA program. Fortunately, Texas A&M provides an advanced degree opportunity precisely fitting this somewhat unusual set of requirements. As discussed more fully in a subsequent section, the Doctor of Engineering Program allowed for development of both technical and non-technical skills that satisfied the short-term educational goal. It also met the requirements of future specific career paths.

### Career Goals

In assessing career opportunities following completion of the Internship, the first decision involved public versus private sector engineering organizations. As noted, the author has worked in both situations and is aware of the limitations and advantages of each. On balance, the public sector has been more challenging and rewarding to the author and he has decided to remain in that area.

Several factors entered into that balance. One of the reasons that originally led to leaving the consulting firm and moving into State government was a concern about the quality of technical expertise in public agencies. The author had not been especially impressed with several public officials, including engineers, who had been in review or approval positions on a number of the consulting firm's projects.

These experiences resulted in an attitude summarized by the popular expression "If you are not part of the solution, you are part of the problem!" Although this was a rather simplistic and idealistic outlook, the author still believes that participation in the public sector, instead of just criticism, is the best and fastest way to improve quality, integrity and expertise in such agencies.

In addition, public works projects generally have a broader impact than private works. The potential satisfaction from seeing the impacts of one's work (when executed properly) is greater. Conversely, because of the expanded arena, the challenge to ensure quality in public works is also greater. One drawback, however, is the often long period between project inception and completion.

Lastly, the variety and scope of work in the public sector, especially in the Corps, is generally greater than in private consulting. There are exceptions, of course, in the form of very large, multinational firms that provide world-wide services or even in very small firms that provide "one stop" engineering in local markets. But the Corps is still the largest constructor in the world and the scope of public projects is difficult to match.

For these and other considerations, the author elected to remain

with the Corps and has accepted a permanent position at WES following the internship. The position is with the Coastal Engineering Research Center as the project manager for their "Evaluation of Navigation and Shore Protection Structures" work unit.

While it may seem somewhat incongruous for an individual pursuing a non-research degree to have as an immediate career goal a position in a research organization such as WES (or CERC), the applicability is actually quite great. Probably ninety percent of the technical staff at WES is engaged in the development of emerging technologies. With few exceptions they are not interested or prepared for anything beyond the R&D process. There is perhaps no better professional environment for an engineer specifically trained to manage and transfer technology than an organization devoted to its creation.

## Benefits of the Doctor of Engineering Program

### Program Intent

The Doctor of Engineering curriculum at Texas A&M provided the ideal solution to the author's desire for training in both the practice and management of professional engineering. The basis for the Doctor of Engineering Program is simply the acknowledgement that technology can not exist in and of itself. It must be considered part of a larger context in origin and certainly in impact.

Society's needs, wants and conflicts are the motives for creation of new technologies and for the inception and execution of engineering projects. Even in cases alleged to be "pure" research for knowledge's sake alone, it is a rare project that continues to be funded for providing solutions to problems that are not of concern to anyone. Obviously, in turn technology and engineering solutions result in an impact back on society.

This iteration between the shaping of future technology by society and the shaping of future society by technology is a true systemic relationship. The Doctor of Engineering Program attempts to prepare engineers to recognize, bridge and manage the relationship.

### Program Coursework Requirements

The program coursework requires technical preparation in a basic discipline, experience in engineering design, required professional development training in accounting, communication, finance, engineering economics, engineering management and engineering law and ethics, and additional elective professional development in non-technical areas.

The author's technical preparation (including Master's work) was based on 44 semester hours of graduate work in coastal engineering, oceanography and civil engineering hydraulics. (This was 12 hours more than the 32 required.) The total does not include 6 additional hours of undergraduate civil engineering courses completed to improve background in structures. The 12 hours of design work was selected to be diverse and provide exposure to the interrelated features of typical coastal or marine projects. It included geotechnical design, marine foundations, steel structure design and hydrology.

The required areas of professional development training are noted above. The electives were selected principally in management and related topics. They included two graduate courses from the management department, one in political science (Formulation of U.S. Ocean Policy), and one introductory course in operations research. The author's intent was to develop a basic foundation in traditional management thought (with quantitative decisionmaking) and provide some introduction to its application in the public sector.

### Internship Requirements

Completion of an internship in engineering is also a program requirement. As the reader is aware, the current document represents the summary of the author's internship and discusses its purposes in detail in Chapter I. Initially the author considered requesting that the College of Engineering waive the requirement for an internship because of extensive past experience. This has occasionally been done for other candidates. However, such a request was not made and the internship was completed for the following reasons.

Experience comes in many forms and varying quality. For example, there can be a distinction between two definitions of "10 years of experience." The first definition could be progressively responsible experience based on insightful learning and growth over 10 years. An alternate definition could be the same one year's experience unimaginatively applied 10 times! The author does not feel that he falls within the latter definition, but he does not fall wholly in the former either. He viewed an internship such as the one completed as a quality assurance tool to provide an unquestioned initial year of organized comprehensive experience from which to continue learning and growth, i.e., a benchmark for future progress.

The second reason involved the relationship between the formal coursework and the internship. It is logical that the experience demonstrating ability to apply training should follow or be concurrent with the training.

Lastly, the internship provided an opportunity to work in a technical area slightly different from past experience. The author viewed this as an opportunity to truly examine his general problem-solving skills and learning ability. In effect the internship prevented him from directly applying previously known results and specific experiences, and challenged the thought processes instead.

#### Summary of Applicability

The formal training provided in the Doctor of Engineering Program was highly relevant in the internship and will be in future assignments. The author found no general area of deficiency in his formal preparation.

He was able to readily assume project management duties including



rapidly developing an operational understanding of COEMIS and the Corps' budget process. His selection as Acting Group Chief was partially based on demonstrated administrative training, skill and leadership and he was able to assume those duties without difficulty.

As discussed in Chapter II, the Internship assignments included technical subtasks performed by others in the areas of state-of-the-art numerical modelling, laboratory testing, field data collection, design, and construction/operations. The author's technical training combined with management and communication skills allowed him to function as necessary across these diverse areas, discussing problem statements, defining scopes of work, realizing types of data required, and reviewing and blending results in an understandable context.

The ability to accomplish this mixture of work during the Internship with almost no prior institutional experience at WES is a direct indicator of the benefit and relevancy of the approach and philosophy of the Doctor of Engineering Program.

## CHAPTER V

### SUMMARY

This report has described an internship completed by the author as part of the Doctor of Engineering Program at Texas A&M University. The author's Internship was performed as a civil engineer and team leader with the Environmental Laboratory of the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. A statement of objectives was prepared at the beginning of the Internship to provide guidance for the experience and to allow for a meaningful assessment at its conclusion.

#### Organization

The first chapter of this report set forth the objectives and described the organizational setting of the internship, key programs and practices, and the general nature of the duties performed.

WES is a unique organization both in mission and structure. It operates on a reimbursable basis to elements of the Corps and other agencies, and has a definite "client" orientation. A variety of work is performed including pure research; product, process and equipment development and testing; and design services. Work is executed through five laboratories at the Station.

The Environmental Laboratory is a multi-discipline organization providing expertise in several program areas such as water quality and environmental effects of dredging. The organization extends down to the Group level, but much of the work is accomplished through a temporarily-

staffed matrix structure. Individuals may be part of several projects at the same time.

The author's Internship appointment was as a Team Leader with administrative responsibility for the technical progress and individuals involved in several dredging-related work units. He also completed the final two months of the Internship as Acting Chief of the Group with full organizational control.

### Assignments

Three specific technical assignments were selected as part of the Internship to provide experiences representative of the variety of topics addressed in the Environmental Laboratory and the types of administrative roles likely to be encountered in engineering practice. Chapter II of this report described in detail the specific assignments and contributions summarized below.

In the Duwamish Waterway Capping Demonstration project the author managed and executed a complete, comprehensive engineering project examining the feasibility of an innovative dredged material disposal technique. He performed an evaluation of site conditions and their influence on the disposal process, calculated and verified with field data a mass balance of the dredged material, and blended these tasks with the technical work of others into a technical report. The project required management of substantial funds and the coordination of the efforts of other professionals at WES and in the cooperating District. The result of the assignment was the most complete and fully documented evaluation of the capping concept to date.

The Indiana Harbor Disposal Alternatives project provided an

opportunity to function as a member of a large interdisciplinary team acting in a consulting role to a District seeking dredging and disposal alternatives for PCB-contaminated sediment. Contributions by the author included recommendations for dredging and disposal equipment based on thorough review of state-of-the-art practices and on a field demonstration of candidate equipment. Preliminary conceptual site designs and construction sequences were developed for further consideration by the client.

In writing a draft Engineer Manual on open-water disposal of dredged material the author identified, collected and synthesized available information on the prediction and control of dredged material movement during disposal. This exercise provided unique experience in summarizing and communicating technical information. After further review, the manual will be used throughout the Corps as the principal design guidance for such projects.

In addition to the three technical assignments, the author served as a Team Leader, effectively performing primary management of the work program, personnel, and fiscal resources.

All assignments were technically challenging and reinforced the need for an integrated view of technical tasks and project administration.

#### **Additional Experiences and Development**

During the Internship the author actively sought opportunities for further training and professional development. These experiences and their value to the Internship were discussed in Chapter III of this report.

Three government-sponsored training courses dealing with management and personnel were completed. This training facilitated the application of managerial concepts learned in formal Doctor of Engineering coursework to a government and Corps context. The courses also used several managerial trait appraisal instruments that provided interesting and valuable insight into personal managerial style.

Additional professional development activities included regular participation in technical societies, interaction with numerous nationally- and internationally-known visitors to WES, and experience in effective technology transfer through publications and client briefings.

## Conclusion

The internship completed by the author was comprehensive in scope, challenging, and fully met the intent of the Doctor of Engineering Program. It resulted in numerous specific contributions detailed in this report and demonstrated the author's ability to function at high levels of technical competency, professional development and managerial skill. Formal training completed during the Doctor of Engineering Program was relevant and facilitated significant contributions within a short time with little institutional experience.

In addition, the internship provided the author with a valuable base of experience in a number of technical areas, in the integrated administration of a work program and in the relationship between the two. All proposed objectives were met and the internship exceeded expectations.

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## APPENDIX A

## DOCTOR OF ENGINEERING INTERNSHIP PROPOSAL

CLIFFORD L. TRUITT

## Introduction

The following is a description of the employment/educational experience proposed in fulfillment of the internship requirement for Clifford L. Truitt as a candidate in the Doctor of Engineering program at Texas A&M University. It is understood that this is a summary proposal and that detailed objectives will be submitted with the second required progress report in accordance with the instructions provided in the Program Manual.

## Background

Mr. Truitt is employed by the Corps of Engineers as a Civil Engineer, GS-810-12, in the Water Resources Engineering Group (WREG). WREG is one of twelve primary level organizational units grouped into four Divisions in the Environmental Laboratory at the US Army Waterways Experiment Station, Vicksburg, Mississippi. This Group is involved with a number of diverse programs spanning technical areas such as dredging operations, confined and open water disposal of dredged material, environmental effects of waterway design, water supply engineering, and landfill design/ leachate control. Because of this tremendous diversity and the broad scope of typical programs, the work of the Group is characterized by a high degree of interaction with other groups, consultants, universities, and with individuals in non-engineering fields.

The Group's work is funded by a balanced combination of direct allotted and reimbursable monies and will reach a level of approximately \$1.6 million this fiscal year.

The Group employs a multi-discipline staff of 23 individuals in professional and support positions. Employees include full and part-time permanent Federal civilian employees, active duty military, and university employees on long-term assignments at WES under Inter-agency Personnel Act (IPA) or similar agreements. The professional staff members all occupy positions classified in either the Civil Engineering or Environmental Engineering series. However, their individual specializations include hydraulics/hydrology, water resources geotechnical, environmental, chemical, and ocean engineering.

Recent growth in the size of the staff and continued diversity in the nature of the workload has led to emerging problems with the span of control presently exercised by management. A primary effort to address this situation centers on organizing Group members into formal "teams" based on similar areas of technical expertise and related focus of work assignments. A team leader is designated to plan and organize assigned work, establish priorities and schedules, provide technical leadership, and to assume certain administrative responsibilities. The position of a team leader encompasses the same technical and engineering duties assigned in common to all members of the professional staff at like grades, but is distinct in the scope and level of required administrative, fiscal, and supervisory duties.



### Internship Assignment

Mr. Truitt is to be assigned as one of two team leaders in the Group and such an assignment and responsibilities are fully appropriate as an Internship experience for the Doctor of Engineering degree at Texas A&M University. Mr. Truitt's supervisor at WES is the Chief of the Water Resources Engineering Group, Dr. Michael R. Palermo. Dr. Palermo holds a Ph.D. degree in Engineering and is a Registered Professional Engineer in Mississippi. He has agreed to serve as the Internship supervisor and a resume is attached.

### Technical Assignments

The nature of the technical or engineering experience which Mr. Truitt will receive is best reflected in a brief description of the projects or work units assigned to him:

a. The first unit is part of the Long-Term Effects of Dredging Operations program. This work examines the feasibility of accurate subaqueous placement and "capping" of contaminated materials in an open water environment. The overall program is highly interdisciplinary and work units are found in almost all Divisions of the Laboratory. The primary research on the techniques and effectiveness has been accomplished in previous years and the current emphasis is on field demonstrations to verify feasibility. One such demonstration was conducted in the Duwamish Waterway in cooperation with the Seattle District of the Corps. Mr. Truitt's objective in this task is to summarize the completed field demonstration including intended design, operational/construction features, data collected and conclusions, and produce a report addressing the engineering feasibility of the design and the operational techniques. Parallel work by others will examine the effectiveness of the chemical isolation achieved, biological impacts, etc.

b. The second assignment is a very large mission support project for the Chicago District, North Central Division of the Corps. Mission support work within the Corps is highly analogous to the work performed in civilian consulting firms. The Chicago District has identified several locations (e.g. Indiana Harbor) where the necessary maintenance dredging work would involve

contaminated sediments. The District has contracted with WES to evaluate a number of dredging/disposal alternatives and provide recommendations, preliminary designs and costs for dealing with the problem. The project is a multi-year effort with several design decision milestones leading to a prototype field demonstration of more feasible alternatives. Mr. Truitt will have charge of the work addressing open water disposal alternatives including site selection, equipment, design of capping options and monitoring/regulatory needs. The objective is to produce a major section of an integrated engineering report that presents feasible, site specific preliminary designs, associated costs, equipment, operational requirements, and a suggested scope for a scaled demonstration project.

c. The third task is the preparation of an Engineer Manual on aspects of open water disposal of dredged material for use by all Corps field agencies. By the very definition of the manual series, no further original research is authorized. Rather, the intent is synthesis of previous work and verified techniques into a practical design/operational tool.

In summary, the scope of Mr. Truitt's technical involvement for the next year includes two tasks directed toward field projects or "consulting" type services, and one strictly involving technology transfer. All the technical work is characterized by the need for a high degree of planning, interaction and coordination with other professionals and with operational personnel, and careful detailed management of limited time, labor, and physical resources.

#### Administrative Duties

In addition to the technical experience, as a team leader Mr. Truitt interacts with the Corps of Engineers Management Information System (COEMIS). He will be responsible for initially programming the available fiscal resources for each work unit, appropriately charging labor, services, and outside contracts, and monitoring the fiscal progress under COEMIS. He is responsible for effectively utilizing the time and expertise of his team members and for identifying and

responding to any shortfalls in resources. A twelve-month Internship will span the next change in fiscal years and provide an opportunity to participate administrative processes unique to Federal agencies.

### Summary

It is suggested that the experience as described above meets or exceeds the expectation of the Internship phase of the Doctor of Engineering program. The Corps at all levels supports a comprehensive formal executive development program including internship assignments, on-the-job training, and temporary appointments to "acting" management positions. The Internship proposed closely parallels such programs and taken with Mr. Truitt's completed and proposed course work should prepare him to progress more readily in grade and responsibility. In addition, the Corps operates under an objectives/performance appraisal personnel management system and any specific experiential or learning goals associated with the Internship can easily be incorporated into and monitored by this system and the supervisor.

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Clifford L. Truitt, PE  
Civil Engineer

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Michael R. Palermo, PhD, PE  
Chief, Water Resources  
Engineering Group

(Drafted and submitted 19 Nov 1984)  
(Revised and filed 02 Aug 1985)

## APPENDIX B

### PUBLICATIONS RESULTING FROM THE INTERNSHIP

The following are publications resulting directly from the author's Internship with the Environmental Laboratory. The products of the specific assignments described in Chapter II are listed together with related work on similar projects.

Cullinane, M.R., (Truitt, C.L.) et al. 1986. "Puget Sound Dredged Material Disposal Alternatives," Miscellaneous Paper in Sponsor Review, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Montgomery, R.L., (Truitt, C.L.) et al. 1986. "Disposal Alternatives for PCB-Contaminated Sediments from Indiana Harbor, Indiana," Miscellaneous Paper in Sponsor Review, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Palermo, M.R., (Truitt, C.L.) et al. 1986. "Evaluation of Dredged Material Disposal Alternatives for US Navy Homeport at Everett, Washington," Miscellaneous Paper in Sponsor Review, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Hayes, D.F., McLellan, T.N., and Truitt, C.L. 1986. "Demonstrations of Innovative and Conventional Dredging Equipment at Calumet Harbor, Illinois," Miscellaneous Paper in Sponsor Review, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Truitt, C.L. 1987. "Engineering Considerations for Capping Subaqueous Dredged Material Deposits: Background and Preliminary Planning," Environmental Effects of Dredging Technical Note 01-03, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Truitt, C.L. 1987. "Engineering Considerations for Capping Subaqueous Dredged Material Deposits: Design Concepts and Placement Techniques," Environmental Effects of Dredging Technical Note 01-04, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

McLellan, T.N., Truitt, C.L., and Palermo, M.R. 1986. "Evaluation of the Matchbox Dredgehead and Submerged Diffuser," Proceedings of the Nineteenth Annual Texas A&M Dredging Seminar and the Eighth Annual Meeting of the Western Dredging Association, Sea Grant Report in press, Texas A&M University, College Station, Texas.

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Truitt, C.L. 1985, "Interim Results for the Duwamish Waterway Capping Demonstration Project," Proceedings of the Eighteenth Texas A&M Dredging Seminar and the Seventh Annual Meeting of the Western Dredging Association, Sea Grant Report No. TAMU-SG-86-105, Texas A&M University, College Station, Texas.

## VITA

## CLIFFORD LEE TRUITT

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The author was born on November 22, 1948, in St. Petersburg, Florida. He is the son of Nan A. Truitt and Leonard G. Truitt (deceased), and is married to Dianne B. Truitt.

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B.S., Physical Oceanography, 1970, Florida Institute of Technology, Melbourne, Florida.

Master of Engineering, Ocean Engineering, 1983, Department of Civil Engineering, Texas A&M University, College Station, Texas.

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## PROFESSIONAL EXPERIENCE:

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